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Our food..

OUR FOOD

By

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and

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GANESH & CO. (MADRAS) PRIVATE LTD.

MADRAS-17

1969

Published by
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MADRAS 17

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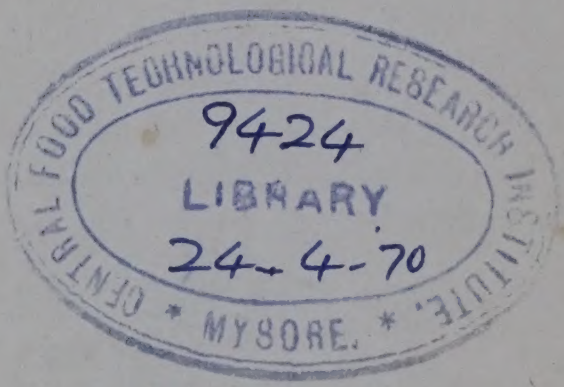
First Edition February, 1959
Second Edition July, 1960
Third Edition October, 1962
***Fourth Edition** (Revised and enlarged) December, 1964*
***Fifth Edition** (Revised and enlarged) September, 1966*
***Sixth Edition** (Revised and enlarged) June, 1969*



Price Rs 6.00
(Foregin $ 1.50 or 10 sh.)

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PRINTED IN INDIA BY K. A. KORULA
AT THE WESLEY PRESS, MYSORE

FOREWORD

It is now about 10 years since the first edition of this book was published. Since then, a large amount of work has been done in the field of food science, technology and nutrition specially for overcoming the deficiencies in the diets of children and expectant and nursing mothers. Although there is deficiency of calcium, vitamin A and some vitamins of B-group in the diet, the largest deficiency in the diet of a majority of preschool children is that of protein and calories. The authors who have considerable experience in the field of nutrition have brought this book up-to-date by addition of new information so that it may find practical application in improving the nutrition of the people. They have particularly stressed the role of processed protein foods in overcoming protein malnutrition. The book will prove of considerable value to all concerned in disseminating the knowledge of nutrition and dietetics among the people.

H. A. B. Parpia
Director
Central Food Technological Research Institute, Mysore

Mysore
May 1969

AN APPRECIATION

The contents of the book reflect a long experien the authors in the field of Food and Nutrition. subject has been dealt with in clear and concise lang which can be easily understood by the layman. wealth of information about the nutritive value of va foods, dietary needs of different age groups espec needs of the vulnerable group and the geriatric gr utility of vegetable milk and curds and about production and requirements in India will be of imm help to the field workers in the Community Developn Blocks in the country. Also the book will not provide ready reference but will serve as guide to doctors, public health nurses, lady health visitors, n wives and health inspectors attached to the prim health centres and the maternity sub-centres in rural areas covered by the Community Developm Programme.

I strongly recommend the book to teachers, gra sevaks, grama sevikas, social education organisers a mukhya sevikas employed in the Community Devel ment Blocks. I hope it will be widely circulated amon women who are primarily responsible for what the fam eats and drinks.

(Sd.) BARKAT NARAIN
COL. I.M.S. (Retd.) F.A.M.S.
Adviser Health and Administrat
Applied Nutrition Programme i
Ministry of Community Developm
and Co-operation 1954–1966

AN APPRECIATION

The book presents accurate knowledge in nutrition orn out of depth of research for application in the lection of foods and preparation of the daily meals for ie family. The subject matter of nutrition as dealt by iese authors can be understood easily even by those ho might not have had previous training in nutrition, nce the emphasis is on fulfilling the nutritional needs the average normal persons. For professors and udents of advanced nutrition also, this book is bound throw light on the nutritional and food problems cing the country and serve as a guide in community utrition.

The book will be highly suitable for beginners in utrition, undergraduate students of Home Science olleges, personnel in Community Development, instruc-rs of Home Science Wings training, grama sevikas, ukhya sevikas, physicians, nurses, pediatricians, dieti-ans and home makers, besides fulfilling the long felt ed for a suitable text book in Higher Secondary Schools d Extension Training Colleges and Centres.

RAJAMMAL P. DEVADAS
M.A., M.Sc., Ph.D. (Ohio State)
Principal
Sri Avinashilingam Home Science College
Coimbatore

PREFACE TO THE SIXTH EDITION

The authors wish to express their thanks
users of the book for the encouraging reception g
the fifth edition. In preparing the sixth editio
general character and scope have been kept mu
same as in the previous edition. Every section
book has been carefully revised. New material has
incorporated in the chapters on (1) Requiremer
dietary essentials, (2) Food production in India
Food Requirements and (3) Balanced diets. Addi
chapters have been added on (1) The Applied Nut
Programme in India, (2) Role of Science and Techn
in augmenting our food resources and (3) Nut
value of common recipes. Additional appendices g
data on the nutritive value of ready-to-serve foods
common Indian recipes have been included. We
these additions will make the book more usefu
students of dietetics and home science and social we
and public health workers.

The authors are grateful to Dr H. A. B. Pa
Director, Central Food Technological Research Instit
Mysore, for writing a foreword and to Col. Barkat Na
for providing material for the chapter on App
Nutrition Programme and for writing an apprecia
of the book.

Mysore
May 1969

M. SWAMINATHA

Extract from the Foreword by Sri Chandra Bhanu Gupta, Chief Minister of Uttar Pradesh to the Hindi Version of 'OUR FOOD'

I am extremely happy and proud to see this book
ıd appreciate the scientists who, in addition to fruitful
search work, are also making best efforts in preparing
aterial on scientific and technological subjects for the
ıblic. This little book shows that our country is
ogressing by leaps and bounds in the field of food
ience and technology.

I am happy to congratulate the Food Specialists
the C.F.T.R.I., who have written this useful book
ı food and nutrition.

It is necessary that we must utilise our food resources
the best way. We should, as far as possible, make
eful changes in our food habits, so that every member
a family in India may get a balanced diet. Everybody
ıould know about balanced food and related information
ıd only then every Indian would be fully conscious of
et and nutrition.

In the book 'Our Food', I have found all useful
formation about foods, their nutritive value and
ıman requirements. The knowledge of diets for
bies, children, young adults, expectant and nursing
others and old people has been presented in simple
nguage and this will prove to be of great use to the
ople in the country.

हमारा आहार

लेखक

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एम.एस.

प्रकथन लेखक
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मद्रास-17

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I. FUNCTIONS OF FOOD

The food we eat everyday contains the following ary essentials: (*i*) Proteins (*ii*) Fats (*iii*) Carbo- rates (*iv*) Mineral salts and (*v*) Vitamins. Food rishes the body in the following ways: (1) It provides body with fuel, such as *fats* and *carbohydrates*, ch are oxidised in the body to supply the *energy* uired for various activities. (2) It provides *proteins* the *building* and *upkeep* of the body tissues. (3) It ishes *vitamins* and *minerals* by means of which the processes in the body are regulated, thereby protect- the body against *ill health.*

Functionally foods are classified as follows:

(*i*) *Energy yielding foods:* Foods rich in carbohydrates and fats are called energy yielding foods. Cereals, roots and tubers, dried fruits, sugars and fats are included in this group. Cereals contain, in addition, fair amounts of proteins, minerals and certain vitamins and form the important sources of the above nutrients in poor dietaries.

(*ii*) *Body building foods:* Foods rich in proteins are called body building foods. Milk, meat, fish, eggs, pulses, oilseeds and nuts and low-fat oil seed flours are included in the group of body building foods.

(*iii*) *Protective foods:* Foods rich in *proteins*, *vitamins* and *minerals* are termed protective foods. Milk, eggs, liver, green leafy vegetables and fruits are included in this group. Protective foods are broadly classified into two groups: (*a*) Foods rich in *vitamins*, *minerals* and *proteins* of high biological value e.g., milk, eggs, meat, fish and liver. (*b*) Foods rich in certain *vitamins* and *minerals* only e.g., green leafy vegetables and fruits.

II. CALORIFIC VALUE OF FOODSTUFFS

The importance of calories

The quantitative requirement of food for the human body is expressed in terms of a unit called the large 'CALORIE'. It is a unit of heat, used as a yardstick for measuring the energy derived from foods by the body. The *calorific value* of a food depends on the quantity of carbohydrates, fats and proteins present in them:

1 gram of *carbohydrate*	yields	4	*calories*
1 gram of *fat*	„	9	„
1 gram of *protein*	„	4	„

Calorific value of foodstuffs

Cereals, pulses, nuts, oils and fats, and sugar form the important sources of calories in the diets of adults and older children. In the case of infants and young children below 2 years of age, milk is an important source of calories besides proteins, vitamins and minerals. The calorific value of certain important foods is given in Table 1.

Table 1. **Calorific value of some foodstuffs**

	Calories (*Per 100 g.*)		*Calories* (*Per 100 g.*)
Oils and Fats		*Sugar, Jaggery and dried fruits*	
Vegetable oils and ghee	900	Cane sugar	400
Butter	731	Jaggery	383
		Raisins, dry	319
		Dates, dry	283
Nuts and oilseeds			
Almond	655		
Cashewnut	596	*Cereals*	
Coconut, fresh	444	Bajra	360
Coconut, dry	735	Cholam (Jowar)	341
Gingelly (sesame) seeds	564	Maize (Corn)	342
Groundnut	549	Oatmeal	374
Walnut	687	Ragi	332

Cereals (cont.)	*Calories (Per 100 g.)*
Wheat	348
Rice, raw, milled	348
Pulses	
Bengal gram	361
Black gram	350
Green gram	350
Horse gram	322
Lentil	340
Peas, dry	350
Red gram	345
Soya bean	432

	Calories (Per 100 g.)
Milk and milk products	
Milk (Buffalo's)	117
Milk (Cow's)	65
Milk (Skimmed, reconstituted)	36
Milk powder, whole	496
Milk powder, skimmed	357
Flesh foods	
Egg, hen's	173
Fish	100
Mutton	194
Liver	150

Energy requirements

The energy requirements depend on (1) Age (2) Height (3) Weight (4) Sex (5) Physical activity etc. The energy requirements of different individuals are given in Table 43.

III. PROTEINS

Proteins are the main constituents of the cells the body and form the greater part of muscle and ot tissues.

Functions of proteins

Proteins have the following important functio (1) Promotion of growth (2) Repair of wear and tear tissues (3) Production of metabolic and digesti enzymes and blood proteins (4) Production of horm nes and (5) Production of antibodies i.e., building up t body defence against infections.

Nutritive value of proteins

Proteins are composed of simpler substances know as *amino acids*. Proteins differ from one another their *amino acid* composition. Out of 19 *amino aci* commonly occurring in proteins, 9 are *essential* in th sense that they are necessary for the growth of animal and must be present in food proteins.

The nutritional classification of amino acids given in Table 2.

The nutritive value of a protein depends on its amin acid make-up. Proteins may be broadly classifie nutritionally into three groups:

(1) *Complete proteins:* Proteins which contain a the essential amino acids in adequate amount and which can support good growth in youn experimental animals e.g., proteins of mil eggs, meat, fish, liver etc.

(2) *Partially complete proteins:* Proteins which ar partially lacking in one or more essentia amino acids and which will promote onl moderate growth in young animals but ca maintain nitrogen equilibrium in adults ar

called partially complete proteins e.g., proteins of cereals, pulses, nuts and oilseeds.

(3) *Incomplete proteins:* Proteins which are completely lacking in one or more essential amino acids and which do not promote any growth in young animals or even maintain nitrogen equilibrium in adult animals are called incomplete proteins e.g., gelatin.

Table 2. **Nutritional classification of the amino acids**

Essential (Indispensable)	Semi Indispensable	Non-essential (dispensable)
Histidine	Arginine*	Glutamic acid
Lysine	Tyrosine†	Aspartic acid
Tryptophan	Cystine†	Alanine
Phenylalanine	Glycine*	Proline
Methionine	Serine*	Hydroxyproline
Threonine		
Leucine		
Isoleucine		
Valine		

* Arginine and glycine are essential for chicks and turkeys. Serine will spare or replace glycine.

† Tyrosine will spare but not completely replace phenylalanine. Cystine will spare but not completely replace methionine.

Factors affecting the utilisation of dietary proteins

The important factors affecting the utilisation of dietary proteins are the following: (1) calorie intake (2) digestibility coefficient of proteins and (3) biological or nutritive value of the proteins. For the maximum utilisation of dietary proteins, the calorie intake should be adequate. If the calorie intake is inadequate, a part of the dietary protein will be wasted in meeting the energy requirements and the protein need will not be satisfied. In the utilisation of dietary proteins, some of the proteins are lost in digestion and in metabolism. The loss of protein in digestion is expressed by the term digestibility coefficient:

Digestibility Coefficient

$$=100\times\frac{\text{Protein intake—loss of protein in digestion}}{\text{Protein intake}}$$

The loss of protein in metabolism is expressed by the term biological value of proteins.

Biological value

$$=100\times\frac{\text{Protein digested—loss of protein in metabolism}}{\text{Protein digested}}$$

The term net protein utilisation takes into account the losses of proteins in digestion and metabolism. It is expressed as follows:

Net Protein Utilisation%

$$=\frac{\text{Digestibility coefficient}\times\text{biological value}}{100}$$

The digestibility coefficient, biological value and net protein utilisation of some dietary proteins are given in Table 3.

Supplementary value between proteins

It is also important to note that proteins from two or more sources can make up each other's amino acid deficiencies, so that by a judicious combination of proteins from different sources, it is possible to meet the protein requirements. For example, proteins of pulses, nuts and oilseeds supplement those of cereals. All animal proteins supplement cereal proteins to a marked extent.

Effects of protein deficiency

Deficiency of protein manifests itself in different ways in the infant and adult. The infant loses weight, shows stunted growth and may succumb to infections. After weaning, prolonged deficiency of proteins may cause a condition known as '*Kwashiorkor*' which is characterised by (1) Impairment of growth (2) Irritability (3) Oedema, which may involve the whole body (4) Dry, lustreless, discoloured hair (5) Dry, lustreless

Table 3. **Digestibility coefficient, biological value and net protein utilisation of certain proteins**

Protein source	Digestibility coefficient	Biological value	Net protein utilisation
Animal proteins			
Egg, hen	100	97	97
Milk, cow	95	85	81
Mutton	96	82	79
Fish	96	80	77
Vegetable proteins			
Cereals			
Bajra, whole	80	61	49
Jowar ,,	81	58	47
Maize ,,	85	60	51
Ragi ,,	80	65	52
Rice, milled	93	75	70
Wheat, whole	85	65	55
Pulses			
Bengal gram dhal	84	62	52
Black gram dhal	82	54	45
Green gram dhal	85	58	49
Red gram dhal	83	56	46
Nuts and Oilseeds			
Coconut	82	67	55
Groundnut	92	56	52
Soya bean (dehusked)	86	64	55

skin which may show cracking and pigmentation (6) Diarrhoea (7) Anaemia (8) Reduced resistance to infection and (9) Fatty liver.

In adults, deficiency of protein in the diet causes (1) Loss of weight (2) Anaemia (3) Reduced resistance to infections and (4) Oedema of the feet and accumulation of free fluid in the abdomen (*Ascites*).

Protein requirements

The protein in the diet should be derived from different sources such as cereals, pulses, nuts and oil

seeds, milk and flesh foods. Since animal proteins possess, in general, a higher nutritive value than vegetable proteins, the diets of children and expectant and nursing mothers should, in particular, contain large amounts of proteins derived from milk, eggs and flesh foods. The protein requirements depend on (1) *Age* and (2) *Physiological state*. The daily protein requirements of different age groups are given in Table 43.

Important sources of proteins

The protein content of some important foods is given in Table 4.

Table 4. **Important sources of proteins**

	Protein (*g*/100*g*.)
Cereals	
Bajra (Cambu)	11.6
Barley	11.5
Cholam (Jowar)	10.4
Italian millet	12.3
Maize (Corn)	11.1
Oatmeal	13.6
Ragi	7.1
Rice, raw, home-pounded	7.5
Rice, raw, milled	7.0
Samai	7.7
Wheat, whole	11.8
Refined wheat flour (maida)	10.2
Nuts and Oilseeds	
Almond	20.8
Cashewnut	21.2
Coconut, fresh	4.5
Gingelly (sesame) seeds	18.3
Groundnut	26.7
Pistachio nut	19.8
Walnut	15.6
Flesh foods	
Egg, hen's	13.3
Egg white	13.3
Egg yolk	13.7
Fish	21.5
Mutton	18.5
Liver	19.3
Pulses	
Bengal gram dhal	22.5
Bengal gram	17.1
Black gram dhal	24.0
Cow gram	24.6
Field bean, dry	24.9
Green gram dhal	24.0
Horse gram	22.0
Lathyrus pea dhal	28.2
Lentil (Masur dhal)	25.1
Peas, dried	19.7
Red gram dhal	22.3
Soya bean	43.2
Milk and Milk products	
Milk, cow's	3.5
Milk, buffalo's	4.3
Milk, goat's	3.7
Milk, human	1.2
Milk powder, skimmed	38.0
Milk powder, whole	25.2

IV. CARBOHYDRATES

Carbohydrates serve as the main source of energy to the body. When consumed in excess, they may be converted into fat and stored in the body. Carbohydrate deficiency in the diet is not likely to occur except in times of food shortage. Cereals, roots and tubers, which are rich in carbohydrates, are the cheapest of foods. The carbohydrates present in foodstuffs include starch and the various sugars.

Classification: The carbohydrates may be classified under the following heads:

1. Monosaccharides (Simple sugars) e.g., glucose, fructose and galactose
2. Disaccharides (Compound sugars) e.g., sucrose, lactose and maltose
3. Polysaccharides:
   (*a*) *Carbohydrates utilised by the body:* Starch, dextrin and glycogen
   (*b*) *Carbohydrates not utilised by the body:* Cellulose, hemicelluloses, pentosans, gums etc.

Monosaccharides (Simple sugars)

Glucose: This sugar occurs in several fruits and honey. The human body uses glucose for the production of energy. The level of glucose in the blood of normal persons is maintained at a fairly constant level (80 to 90 mg. per 100 ml blood.) In the disease, *diabetes mellitus*, the level of glucose in the blood increases. The urine of normal human beings does not contain any detectable amount of glucose but the urine of diabetic patients may contain upto 6 to 7 per cent glucose. Glucose is used for providing energy to sick persons as it is less sweet than cane sugar and is readily absorbed and utilised.

Fructose: Fructose occurs in fruits and honey. It is about 2.5 times sweeter than glucose. Fructose consumed in the diet is rapidly converted in the body into glucose.

Galactose: Galactose does not occur in the free state in common foods. It occurs in combination with glucose in the sugar lactose of milk. Galactose consumed in the form of lactose is converted to a large extent into glucose in the body.

Disaccharides

Sucrose (*Cane sugar, beet sugar*)*:* Sucrose occurs in large amounts in sugar cane, beet root and palm juice. It also occurs along with glucose and fructose in several fruits. On hydrolysis, it yields a mixture of glucose and fructose known as *invert sugar*. Sucrose is 1.5 times sweeter than glucose. Cane sugar consumed in the diet is not absorbed as such but is hydrolysed to glucose and fructose during digestion and absorbed.

Lactose (*Milk sugar*)*:* It occurs in human milk and in the milk of all mammals. It is composed of one glucose unit and one galactose unit. Lactose consumed in the diet is not absorbed as such but is hydrolysed to glucose and galactose during digestion and absorbed. It has only a slight sweet taste.

Maltose: Maltose occurs in malt obtained from germinated cereals. It contains two molecules of glucose. Maltose consumed in the diet is not absorbed as such but is hydrolysed to glucose during digestion and absorbed.

Polysaccharides

Carbohydrates utilised by the body

Starch: This occurs in large amounts in all cereals, roots and tubers. Starch is formed in plants by the combination of a large number of glucose units. Starch consumed in the diet is converted into glucose during digestion and absorbed as glucose. Starch is the main source of energy in diets consumed by children and adults.

Dextrins: Dextrins are complex polysaccharides composed of a large number of glucose units. They do not occur normally in large amounts in common foods. They are formed by the partial hydrolysis of starch during the preparation of malt from cereal grains. Dextrins consumed in the diet are hydrolysed to glucose during digestion and absorbed as glucose.

Glycogen: This is found in liver and muscle of mammals and human beings. It is the reserve polysaccharide of the body. Glycogen is a polysaccharide composed of a large number of glucose units. Glucose absorbed from the diet is converted into glycogen in the liver.

Carbohydrates not utilised by the body

The most important carbohydrates found in foods of plant origin and not utilised by the body are cellulose, hemicelluloses, gums, mucilages, pentosans, pectin etc. These are not acted upon by the digestive juices and hence are voided in the faeces.

Fibre (cellulose and hemicelluloses)

Fibre or roughage consists of cellulose and hemicelluloses. These carbohydrates are not digested by the digestive juices. They are left unchanged after digestion.

Functions of fibre

Though contributing little to the nutritive value of the food, the presence of fibre in the diet is helpful in the evacuation of the bowels. It prevents the tendency to constipation.

Fibre content of foods

Whole cereals and vegetables are fair sources of fibre. The fibre content of foods is given in Table 36.

Disorders of carbohydrate metabolism

Carbohydrate utilisation is affected in the disease called *diabetes mellitus*. In this condition, the body is not able to utilise the carbohydrates in sufficient amounts.

There is excess of glucose in the blood and some of the glucose is excreted in the urine. Diets low in carbohydrates are usually prescribed for patients suffering from *diabetes mellitus*.

Carbohydrate requirements

Carbohydrates supply about 50-80 per cent of the calories in the diet, depending on the economic status and age of the individual. In balanced diets, about 50-60 per cent of the energy in the diet is supplied by carbohydrates.

Important sources of carbohydrates

Cereals are the most important sources of carbohydrates. Roots and tubers are next in importance. Pulses and fruits are moderate sources of carbohydrates. Some amount of carbohydrate is also being consumed in the form of pure sugar or jaggery. The carbohydrate content of some important foods is given in Table 5.

Table 5. **Important sources of carbohydrates**

	Carbohydrate (g/100 g.)		*Carbohydrate (g/100g.)*
Pure carbohydrate foods		*Pulses*	
Sugar	99.8	Bengal gram dhal	58.9
Jaggery	95.0	Black gram dhal	60.3
Honey	79.5	Cow gram	55.7
Sago	87.2	Field bean	60.1
Arrowroot flour	83.1	Green gram	60.7
Cereals		Masur dhal	59.7
Bajra (Cambu)	67.1	Red gram dhal	60.2
Barley	69.3	*Roots and Tubers*	
Cholam (Jowar)	70.3	Potato	22.9
Maize (Corn)	66.2	Sweet Potato	31.0
Oatmeal	62.8	Tapioca, fresh	38.7
Ragi	73.0	Tapioca flour	85.5
Rice, raw, home-pounded	76.2	*Fruits*	
Rice, raw, milled	79.3	Dates dried	67.3
Rice, parboiled, milled	77.7	Raisins, dried	77.3
Wheat, whole	71.2	Prunes, dried	71.0
Wheat flour (maida)	74.1	Figs, dried	68.0
		Fresh fruits	15-25.0

V. FATS

Chemical composition

Fats are esters formed by the combination of glycerol with fatty acids. The fatty acids commonly occurring in fats are broadly grouped under two heads (1) Saturated fatty acids e.g., Palmitic acid, stearic acid and arachidic acid and (2) Unsaturated fatty acids e.g., Oleic acid, linoleic acid, linolenic acid and arachidonic acid. Three of the unsaturated fatty acids viz., linoleic acid, linolenic acid and arachidonic acid have been found to be essential for the nutrition of animals and human beings.

Fats which are fluids below 20°C are called oils e.g., all common vegetable oils. All animal fats contain a sterol called cholesterol while vegetable fats contain a sterol called phytosterol.

Functions

Fats serve as a source of energy along with carbohydrates and are also stored in the body beneath the skin (subcutaneous fat or depot fat) and to some extent in other parts of the body. Fat in the diet serves as a carrier for the fat soluble vitamins (A, D, E and K). Fat also supplies certain *essential fatty acids* which are needed by the body. Essential fatty acids are linoleic, linolenic and arachidonic acids.

Effects of deficiency

No specific effects of fat deficiency are known in human beings. Even in the absence of fat in the diet, carbohydrates and proteins are converted into fat to some extent in the body. But prolonged deficiency of fat in the diet may cause the following effects: (1) Dryness of the skin (2) Secondary deficiency of the fat soluble vitamins (A, D, E and K) (3) Since the essential fatty acids are not being supplied, eczema-like skin conditions may develop in some individuals,

particularly in children and (4) Deficiency of essential fatty acids may be one of the causes in *phrynoderma.* (see vitamin A deficiency).

Effects of excess fat in the diet

Excessive consumption of fats may cause the following effects: (1) Obesity (2) Digestive disturbances, particularly in children (3) When large amounts of animal fats are consumed, cholesterol present in them may accumulate in the blood and may get deposited on the walls of the blood vessels, causing a disease known as *Atherosclerosis* and finally heart disease (4) Accumulation of excessive amounts of cholesterol in the gall bladder may cause stones in the gall bladder and (5) In a diabetic patient, consumption of excess of fat may produce excessive amounts of acetone bodies which may lead to serious consequences like severe acidosis and coma, resulting even in death.

Fat content of foods

The important sources of fat in the diet are given in Table 6.

Table 6. **Important sources of fat**

	Fat (*g*/100 *g.*)		*Fat* (*g*/100 *g.*)
Oils and fats		Pistachio nut ..	53.5
Ghee ..	100	Walnut ..	64.5
Butter ..	81	Soya bean ..	19.5
Vegetable oils		*Milk and Milk products*	
Groundnut, sesame, mustard and coconut oils ..	100	Cow's milk, whole ..	3.6
		Buffalo milk, whole ..	8.8
Vanaspati (Hydrogenated vegetable fat) ..	100	Khoa (from whole cow's milk) ..	15.2
Nuts and Oil seeds		Khoa (from whole buffalo's milk) ..	31.2
Almond ..	58.9	Whole milk powder ..	26.7
Cashewnut ..	46.9	*Flesh foods*	
Coconut (fresh) ..	41.6	Egg, hen's ..	13.3
Coconut (dry) ..	65.0	Mutton ..	13.3
Gingelly (sesame) seed	43.3	Liver ..	3.0
Groundnut ..	40.1	Fish ..	3.2

Essential fatty acid (EFA) content of fats and oils

The most important sources of EFA are certain vegetable fats. Animal fats in general (except fish oils) are poor sources. The EFA content of common oils and fats and foodstuffs containing fats are given in Table 7.

Vegetable fats and oils: Among vegetable fats and oils, the rich sources of EFA are safflower seed oil, niger seed oil, soya bean oil, linseed oil, sunflower oil, cottonseed oil, sesame oil and corn oil; good sources are groundnut oil, olive oil, rapeseed oil and poor sources are coconut oil and palmkernel oil.

Animal fats: Among animal fats, the fat of egg yolk, hen and pig are good sources, fish fats are moderate sources, while ox and sheep fats are poor sources of EFA.

Hydrogenated fats: When fats are completely hydrogenated, they obviously lose all the EFA present. But partially hydrogenated fats and blends of fully hydrogenated fats and refined oils may contain appreciable amounts of EFA.

Milk fat: Milk fats are poor sources of EFA.

Table 7. **Essential fatty acid content of certain common fats and oils**

Name of fat or oil	Linoleic acid (%)	Linolenic acid (%)
Vegetable Oils and Fats		
Coconut	2.6	—
Corn	39.1	—
Cottonseed	30.4	—
Linseed	46.7	60.9
Niger	53.5	—
Olive	15.0	—
Groundnut	27.4	—
Rapeseed	29.0	—
Safflower	78.0	—
Sesame	40.4	—
Soya bean	58.5	—
Milk fats		
Cow's	3.8	—
Goat's	1.5	—
Buffalo's	2.8	—
Animal fats		
Egg yolk	21.7	2.9
Ox depot fat	5.5	—
Pig depot fat	15.6	—
Sheep depot fat	5.0	—
Hydrogenated fats		
Vanaspathi (hydrogenated groundnut oil)	4.9	—
Margarine	4.8	—

VI. VITAMINS

Apart from proteins, carbohydrates, fats and minerals, there are certain other substances present in minute amounts in most foodstuffs which are necessary for growth and health. They are called vitamins. Several vitamins have been discovered so far but for humans the most important are the following:

(1) Vitamin A and Carotene
(2) ,, D
(3) ,, B_1 (Aneurin, Thiamine)
(4) Riboflavin
(5) Nicotinic acid (Niacin)
(6) Vitamin C (Ascorbic acid)
(7) Vitamin B_{12}
(8) Folic acid
(9) Pyridoxine, and
(10) Pantothenic acid.

VITAMIN A AND CAROTENE

Vitamin A is present only in foods of animal origin, while plant foods contain certain pigments called carotenes (carotenoids) which are converted into vitamin A in the body.

Functions

Vitamin A is essential for the integrity of epithelial tissues and is a stimulus for new cell growth. It also helps to maintain resistance to infections. It is necessary for maintaining the eye in healthy condition and for proper vision in dim light.

Effects of deficiency

A continued deficiency of this vitamin in the diet causes the following disorders.

Night blindness: This is a condition in which the subject is not able to see objects clearly in dim light.

Xerophthalmia and keratomalacia: The outer layers of the eye ball (*Conjunctiva*) become dry and wrinkled causing itching and a burning sensation accompanied by redness, inflammation and photophobia. The cornea of the eye becomes dry and lustreless and eventually opaque and soft. This may ultimately result in total blindness if not treated in time.

Bitot's spots: These appear as greyish white patches, sub-triangular in shape on the outer quadrant of the sclerotics. These are commonly seen in children suffering from chronic vitamin A deficiency.

Phrynoderma: This is a condition in which small pin point projections appear especially on the back of the arms, legs, and on the shoulders and lower abdomen giving the appearance of the skin of a toad. There is some evidence indicating that, besides vitamin A deficiency, deficiency of essential fatty acids may also be involved in this condition.

Defective Teeth: Vitamin A deficiency interferes with the formation of enamel. Hence the teeth formed will be defective and are likely to contain pits and fissures which predispose the teeth to decay.

Reduced resistance to infection: Vitamin A deficiency impairs the structure and functions of epithelial membranes, and hence lowers the resistance of the body to infection, particularly to respiratory diseases.

Tendency for the formation of kidney stones: Vitamin A deficiency makes the individual susceptible to the formation of 'stones' in the urinary tract.

Daily requirements of vitamin A

The daily requirements of vitamin A for the different age groups are given in Table 43.

Vitamin A content of foods

The vitamin A activity of foods, expressed in International Units (I.U.), is given in Table 8.

Table 8. **Important sources of vitamin A and carotene**

1. *Foods containing carotene*

	Vitamin A value (I.U. per 100g.)
Red palm oil	40,000-50,000
Green leafy vegetables	
Amaranth leaves	2,500-11,000
Cabbage	2,000
Coriander leaves	10,460-12,600
Curry leaves	12,600
Drumstick leaves	11,300
Fenugreek leaves	3,900
Radish leaves	6,700
Mint	2,700
Spinach	5,500
Other vegetables	
Carrot	2,000-4,300
Pumpkin, yellow	1,000
Fruits	
Jack fruit	540
Mango, ripe	4,800
Papaya, ripe	2,020
Orange	350
Tomato, ripe	320

2. *Foods containing vitamin A*

Fish liver oils	(*I.U. per gram*)	(*I.U. per teaspoon*)
Halibut liver oil	20,000	60,000
Shark liver oil	3,000-20,000	9,000-60,000
Cod liver oil	2,000	6,000
Shark liver oil (Indian Pharmacopoeia)	2,000	6,000

Note: One teaspoonful of cod or shark liver oil will supply the daily requirements of vitamin A.

Foods containing vitamin A (cont.)

		Vitamin A value (I.U. per 100g.)
Other foods		
Liver, goat or sheep	..	22,300
Egg, whole	..	2,200
Egg yolk	..	3,600
Butter	..	2,500
Ghee, fresh	..	2,000
Fatty fish	..	100
Milk, whole (cow's or buffalo's)	..	180
Milk, human	..	208
Milk powder, whole	..	1,400

VITAMIN D

Functions

Vitamin D increases the absorption of calcium and phosphorus and regulates their concentration in the blood. It directly helps in the formation of hard and healthy bones and teeth.

Effects of deficiency

Deficiency of vitamin D causes *rickets* in children and *osteomalacia* in adults.

Rickets is characterised by delayed and irregular dentition, stunted growth and soft and curved bones.

Osteomalacia is characterised by softened bones, curved spine and pelvic deformity. This occurs generally in women who observe purdha and remain indoors.

Daily requirements

The daily requirements of vitamin D are given in Table 43.

Vitamin D content of foods

Vitamin D occurs mainly in foods of animal origin and is present only in a few foods. The vitamin D

contents expressed in International units (I.U.), are given in Table 9.

Table 9. **Important sources of vitamin D**

Fish liver oils	(*I.U. per g.*)	(*I.U. per teaspoon*)
Halibut liver oil	1,200	3,600
Cod liver oil	100	300
Shark liver oil	50-150	150-450

Other foods	(*I.U. per 100 g.*)
Butter	40
Eggs	100
Milk, whole	2
Milk powder, whole	16
Liver, goat or sheep	40
Fatty fish	50-100

Note: Vitamin D is not present in common foods of vegetable origin.

VITAMIN B_1 (THIAMINE, ANEURIN)

Functions

Vitamin B_1 plays an important part in carbohydrate metabolism. It is essential for the maintenance of good appetite and normal digestion. It is also required for the normal functioning of nerve tissues.

Effects of deficiency

A mild deficiency of this vitamin in the diet results in *anorexia* (loss of appetite), digestive disturbances and vague neuritic pains. A frank deficiency for a prolonged time causes a disease known as *beriberi*. *Beriberi* is of two types: (1) *Dry beriberi* and (2) *Wet beriberi*.

Dry beriberi is characterised by (1) Loss of appetite (2) Tingling and numbness of the legs and hands

(3) Paralysis of the legs and hands (4) Drooping feet and (5) A peculiar stamping gait.

Wet beriberi is characterised by (1) Oedema of legs and abdomen due to accumulation of fluid (2) Enlargement of the heart and signs of heart failure (3) Palpitation and breathlessness.

Daily requirements

The daily requirements of vitamin B_1 are given in Table 43.

Vitamin B_1 content of foods

The vitamin B_1 content of foods is given in Table 10.

Table 10. **Important sources of vitamin B_1**

	Vitamin B_1 (*mg./100g.*)
Dried yeast	3-6
Rice polishings (from raw paddy)	2.1
Wheat germ	2.2
Cereals	
Wheat, whole	0.54
Bajra (Cambu)	0.33
Cholam (Jowar)	0.35
Ragi	0.42
Italian millet	0.59
Barley	0.45
Oats	0.54
Rice, raw, husked	0.40
Rice, raw, home-pounded or undermilled	0.22
Rice, raw, milled	0.11
Rice, parboiled, undermilled or home-pounded	0.32
Rice, parboiled, milled	0.22
Rice, beaten	0.21
Rice, puffed (from paddy)	0.22
Rice, puffed (from rice)	0.10
Pulses	
Bengal gram	0.45
Green gram	0.46
Black gram	0.45
Masur dhal	0.43
Red gram dhal	0.45
Field bean	0.52
Cow gram	0.50
Horse gram	0.42
Soya bean	0.73
Nuts and oilseeds	
Groundnut	0.9
Cashewnut	0.63

	Vitamin B_1 (*mg./100g.*)
Nuts and oilseeds (cont.)	
Gingelly (sesame) seeds	1.01
Almond	0.44
Coconut, fresh	0.05
Pistachio nut	0.67
Walnut	0.45
Other foods	
Milk, whole	0.05
Egg, hen's	0.13
Mutton	0.18
Liver	0.36
Fish	0.10

Note: 1. Important sources of vitamin B_1 in the diets of adults are whole cereals, pulses, nuts and oilseeds.

2. Milk is an important source of vitamin B_1 in the diets of infants and young children.

RIBOFLAVIN

Functions

Riboflavin is concerned in the oxidation of carbohydrates, proteins and fats.

Effects of deficiency

(1) Burning sensation of the eyes, lips and tongue (2) Inflammation and vascularisation of the cornea of the eyes (3) Dimness of vision (4) Fissuring at the angles of the mouth (*Cheilosis* and *Angular stomatitis*) (5) Inflammation of the tongue *Glossitis* and (6) *Dermatitis* over the naso-labial folds, behind the ears, scrotal skin etc.

Daily requirements

The daily requirements of riboflavin are given in Table 43.

Riboflavin content of foods

The important sources of riboflavin are given in Table 11.

Table 11. **Important sources of riboflavin**

	Riboflavin (mg./100g.)
Dried yeast	4.50
Liver, goat or sheep	3.20
Milk powder, whole	1.36
Milk powder, skimmed	1.64
Milk, whole (cow's or buffalo's)	0.20
Egg, hen's	0.35
Egg yolk	0.43
Egg white	0.22
Green leafy vegetables	0.10-0.16
Amaranth	0.10
Fenugreek leaves	0.16
Spinach	0.11
Pulses	
Bengal gram	0.21
Black gram	0.22
Cow gram	0.21
Green gram	0.26
Lentil (Masur dhal)	0.23
Red gram	0.22
Soya bean	0.32
Cereals	
Whole cereals	0.10-0.16
Milled cereals	0.03-0.08

Note: 1. Important sources of riboflavin in the diet are milk, eggs, liver, green leafy vegetables and pulses.

2. Milled cereals are poor sources of riboflavin.

NICOTINIC ACID (NIACIN)

Functions

Nicotinic acid (Niacin) and Nicotinamide (Niacinamide) have the same vitamin activity. They take part in the metabolism of carbohydrates, fats and proteins.

Effects of deficiency

Severe nicotinic acid deficiency causes a disease known as *pellagra* characterised by the following symptoms: (1) Dark pigmentation and dermatitis of exposed parts of the body (2) Soreness of mouth and tongue (3) Diarrhoea (4) Mental disturbance and (5) Anaemia.

Daily requirements

The daily requirements of nicotinic acid are given in Table 43.

Nicotinic acid content of foods

The important sources of nicotinic acid are given in Table 12.

Table 12. **Important sources of Nicotinic acid**

	Nicotinic acid (mg./100g.)		*Nicotinic acid (mg./100g.)*
Dried yeast	.. 27.0	Rice, raw, undermilled (home-pounded)	.. 2.2
Liver, goat	.. 17.6	Rice, raw, milled	.. 1.0
Groundnut	.. 14.1	Rice, parboiled and undermilled (home-pounded)	.. 3.5
Groundnut flour	.. 19.5	Rice, parboiled, milled	2.4
Mutton	.. 6.8	Bajra (Cambu)	.. 2.3
Fish	.. 3.0	Cholam (Jowar)	.. 1.8
Pulses	1.5 to 2.5	Maize (Corn)	.. 1.2
Cereals			
Wheat, whole	.. 5.0		
Rice, raw, husked	.. 3.5		

Note: 1. Important sources of nicotinic acid in the diet are whole cereals, groundnut, liver and mutton.

2. Maize (corn) is a poor source of nicotinic acid and diets based mainly on maize and containing little of other foods are likely to give rise to *pellagra*.

3. Vegetables, fruits, milk and eggs are poor sources of nicotinic acid.

4. The body is able to synthesise a certain amount of nicotinic acid from the amino acid tryptophan present in proteins.

FOLIC ACID

Functions

Folic acid stimulates the formation of red blood cells in the bone marrow. It also stimulates the formation of white blood corpuscles.

Folic acid deficiency

Deficiency of folic acid in the diet results in the development of *macrocytic anaemia*. This condition commonly occurs in pregnant women subsisting on ill-balanced diets.

Folic acid content of foods

The folic acid content of some important foods is given in Table 13.

Table 13. **Folic acid content of foods**
(*micrograms per 100 g.*)

	Folic acid			*Folic acid*
Cereals		*Vegetables*		
Barley	.. 12	Amaranth leaves	..	31
Maize (Corn)	.. 11	Beans	..	5
Oats	.. 14	Beet root	..	6
Rice, raw, husked	.. 12	Cabbage	..	2
Rice, raw, milled	.. 8	Carrot	..	5
Cholam (Jowar)	.. 12	Cucumber	..	6
Wheat	.. 13	Lettuce	..	25
Other whole cereals (unspecified)	.. 12	Potato	..	3
		Pumpkin	..	6
		Sweet potato	..	5
		Spinach	..	32
Pulses		Tomato	..	5
Field bean	.. 24	Other green leafy vegetables (unspecified)	..	30
Soya bean	.. 30	Non-leafy vegetables (unspecified)	..	5
Peas, dried	.. 24			
Other pulses (unspecified)	24			
Nuts and oilseeds		*Milk*		
Almond	.. 15	Milk, cow's	..	1.5
Groundnut	.. 16	„ buffalo's	..	1.4
Coconut fresh	.. 7	„ human	..	1.1

Fruits	*Folic acid*	*Flesh foods*	*Folic acid*
Apple	6	Liver, ox	150
Banana	8	„ lamb	160
Grape fruit	7	„ pig	180
Grapes	6	Chicken	10
Lemon	9	Egg, hen's	10
Orange	7	Beef	15
Pears	8	Mutton, lamb	14
Mango	6	Fish	15

It is evident from Table 13 that whole cereals, pulses and green leafy vegetables are the most important sources of folic acid in the average Indian dietaries.

VITAMIN B_{12}

Vitamin B_{12} is identical with the antipernicious anaemia factor occurring in liver. It stimulates the formation of red blood cells.

Vitamin B_{12} deficiency

Severe vitamin B_{12} deficiency causes *Macrocytic anaemia.* This condition commonly occurs in pregnant women subsisting on ill-balanced diets.

Requirements: The daily requirements of vitamin B_{12} range from 0.5 to 2 micrograms depending on age and physiological state and are given in Table 43.

Vitamin B_{12} content of foods

Vitamin B_{12} is not present in foods of vegetable origin. It occurs only in foods of animal origin. The vitamin B_{12} content of some foods is given in Table 14.

Table 14. **Vitamin B_{12} content of foods**

	Vitamin B_{12} (microgram/100g.)		*Vitamin B_{12} (microgram/100g.)*
Liver, ox	.. 118	Egg, duck's	.. 8.6
„ sheep	.. 133	Milk, cow's	.. 0.60
„ goat	.. 120	„ buffalo's	.. 0.35
„ pig	.. 59	„ human	.. 0.02
Mutton, goat	.. 10.5	„ goat's	.. 0.09
„ sheep	.. 30.0	„ powder (skimmed)	.. 3.0
Fish	.. 23.0	„ powder (whole)	2.3
Egg, hen's	.. 10.4		

VITAMIN C (ASCORBIC ACID)

Functions

Vitamin C is necessary for the formation and maintenance of the intracellular cement substances and for hastening the healing of wounds and of bone fractures. It is also probably necessary for the maturation of the red blood cells.

Effects of deficiency

Deficiency of vitamin C in the diet causes the disease known as *scurvy* which is characterised by the following symptoms: (1) Weakness and irritability (2) Bleeding under the skin and in the joints (3) Tender, swollen and bleeding gums (4) Failure of healing or delayed healing of wounds and of bone fractures (5) Anaemia and (6) Weak bones which easily fracture.

Daily requirements

The daily requirements of vitamin C are given in Table 43.

Vitamin C content of foods

The important sources of vitamin C are given in Table 15.

Table 15. **Important sources of vitamin C (Ascorbic acid)**

	Vitamin C (mg./100g.)
Fruits	
Amla (Indian gooseberry)	700
Guava	300
Lime juice	63
Orange	68
Pineapple	63
Mango, ripe	24
Papaya, ripe	46
Cashew fruit	60
Apple	2
Banana	1
Jack fruit	10
Tomato, ripe	32
Green leafy vegetables	
Amaranth leaves	173
Brussels sprouts	72
Cabbage	124
Coriander leaves	135
Drumstick leaves	220
Ipomoea leaves	137
Spinach	48
Radish leaves	65
Other Vegetables	
Bitter gourd	88
Brinjal	23
Cauliflower	66
Clusterbeans	49
Drumstick (edible portion)	120
Knol khol	85
Ladies finger	16
Tomato, green	31
Vegetable marrow	18
Roots and Tubers	
Beet root	88
Onion	11
Potato	17
Radish	15
Sweet potato	24
Germinated pulses	10-18
Germinated Bengal gram	15
Germinated green gram	16

OTHER VITAMIN

Apart from the vitamins already mentioned, there are others which are required for human nutrition. The importance of some of these to man has not been completely established. Nevertheless, they must be present in the diet to make it really complete. The following table gives a brief account of these vitamins:

Name of the vitamin	Function as shown by animal experiments	Important sources
Vitamin E ...	Essential for reproduction, prevents abortion and muscular dystrophy.	Wheat germ oil, rice germ oil, cottonseed oil, groundnut oil and germs of cereals and pulses.
Vitamin K ...	Essential for clotting of blood.	Common leafy vegetables, cauliflower, pork, liver.
Vitamin B_6 (Pyridoxine) ...	Essential for fatty acid and amino acid metabolism.	Rice polishings, whole cereals, wheat germ, liver, nuts, oilseeds, pulses, egg yolk, milk curds, lettuce, spinach.
Pantothenic acid	Growth, maintenance of normal skin and hair, oxidation of carbohydrates and fats.	Cereals, pulses, nuts and oilseeds, liver, beef, pork, kidney, eggs.
Biotin ...	Deficiency causes skin changes, lassitude, loss of appetite and anaemia.	Liver, kidney, chicken, milk, spinach, peas.
Inositol ...	Prevents accumulation of fat in the liver.	Present in all foods.
Choline ...	Prevents accumulation of fat in the liver, necessary for formation of acetylcholine and phospholipids.	Cereals, pulses, nuts and oil seeds, pork, liver, eggs, milk.

Note: A balanced diet normally contains adequate amounts of all the above vitamins.

VII. MINERALS

The body contains 19 minerals, all of which must be derived from food. These include calcium, phosphorus, potassium, sodium, chlorine, magnesium, iron, manganese, copper, iodine, cobalt, zinc, aluminium, arsenic, bromine, fluorine and molybdenum.

These minerals are necessary for four main purposes:

(1) As constituents of bones (i.e., the rigid structures which support the muscular system of the body) and teeth. Minerals having this function are calcium, phosphorus and to a lesser extent, magnesium.

(2) As constituents of body cells, of which muscle, blood corpuscles, liver, etc., are composed. Minerals having this function include iron and phosphorus.

(3) As soluble salts which give to the body fluids their composition and stability which are both essential for life. Among elements which serve this purpose are sodium, potassium, chlorine and phosphorus.

(4) Some minerals are required in small quantities for specific functions e.g., (*a*) iron and copper—formation of haemoglobin (*b*) iodine—formation of thyroxine (*c*) zinc—constituent of an enzyme and (*d*) cobalt—constituent of vitamin B_{12}.

In poor Indian dietaries, deficiencies of calcium and iron commonly occur. Iodine deficiency occurs in people living in certain hilly tracts in India. Addition of extra sodium chloride to the diet is of special importance in a tropical country like India. The deficiencies of other minerals do not normally occur in average diets.

CALCIUM AND PHOSPHORUS

Functions of calcium and phosphorus

(1) They form the major constituents of bones and teeth and are essential for their formation.

(2) They are present as soluble salts in all the fluids of the body and they supply the necessary electrolytes for the action of muscles and nerves.

(3) Calcium participates in blood coagulation.

(4) Phosphorus plays an essential part in the complex processes by which the body obtains the release of energy from carbohydrates and fats.

Effects of calcium deficiency

Calcium deficiency may cause the following effects:

(1) Rickets (as in Vitamin D deficiency) (2) Tetany (3) Hyper-irritability (4) Decay of the teeth and (5) excessive bleeding due to delayed coagulation.

Daily requirements of calcium

The daily requirements of calcium are given in Table 43.

Calcium and phosphorus contents of foods

The important sources of calcium and phosphorus in the diet are given in Tables 16 and 17.

Table 16. **Important sources of calcium**

	Calcium (g./100g.)		*Calcium (g./100g.)*
Milk and milk products		*Pulses*	
Milk, cow's	0.12	Bengal gram dhal	0.07
Milk, buffalo's	0.21	Black gram dhal	0.20
Milk, goat's	0.17	Green gram dhal	0.14
Curds from cow's milk	0.12	Red gram dhal	0.14
Milk powder, skimmed	1.37		
Milk powder, whole	0.95	*Nuts and oilseeds*	
Cheese	0.79	Gingelly (sesame) seeds	1.45
Khoa (from whole buffalo's milk)	0.65	Almond	0.23
Cereals		*Green leafy vegetables*	
Ragi	0.33	Sesbania leaves	1.13

Green leafy vegetables (Cont.)	*Calcium (g./100g.)*
Amaranth leaves	0.50
Carrot „	0.34
Curry „	0.81
Drumstick „	0.44
Mint	0.20
Flesh foods	
Small fish, dried	1.8

Note: 1. Milk, green leafy vegetables, ragi and gingelly seeds are the most important sources of calcium in the diet.

2. Rice is a poor source of calcium.

Table 17. **Important sources of phosphorus**

	Phosphorus (g./100g.)
Milk and Milk products	
Milk, cow's	0.09
Milk, buffalo's	0.13
Milk powder, skimmed	1.00
Milk powder, whole	0.73
Cheese	0.52
Khoa (from whole buffalo milk)	0.42
Flesh foods	
Egg, hen's	0.22
Egg, duck's	0.26
Fish	0.41
Mutton	0.24
Liver, sheep	0.38
Cereals	
Bajra (Cambu)	0.35
Barley	0.23
Cholam (Jowar)	0.28
Italian millet	0.29
Maize (Corn)	0.33
Oatmeal	0.38
Ragi	0.27
Rice, raw, husked	0.23
Rice, raw, home-pounded	0.21
Rice, raw, milled	0.11
Rice, parboiled, home-pounded	0.22
Rice, parboiled, milled	0.17
Wheat, whole	0.32
Wheat flour (maida)	0.09
Pulses	
Bengal gram dhal	0.31
Black gram dhal	0.37
Cow gram	0.49
Field bean, dry	0.45
Green gram dhal	0.28
Horse gram	0.39
Lentil (Masur dhal)	0.25
Peas, dried	0.30
Red gram dhal	0.26
Soya bean	0.69
Nuts and oilseeds	
Almond	0.49
Cashewnut	0.45
Coconut, fresh	0.24
Gingelly (sesame) seeds	0.57
Groundnut	0.39

Note: 1. Most of the common foodstuffs are rich in phosphorus.

2. The phosphorus present in milk and animal foods is available to a greater extent than that present in cereals, pulses, nuts and oilseeds.

IRON

Functions

Iron is present in haemoglobin, which is an important constituent of the red blood cells. Haemoglobin has the important function of transporting oxygen to the tissues. Iron is required for the formation of haemoglobin.

Effects of deficiency

Prolonged deficiency of iron in the diet prevents the formation of haemoglobin and hence causes *anaemia*.

Daily requirements

The daily requirements of iron are given in Table 43.

Iron content of foods

The important sources of iron are given in Table 18.

Table 18. **Important sources of Iron**

	Iron (*mg./100g.*)			*Iron* (*mg./100g.*)
Cereals		*Miscellaneous foods*		
Bajra (Cambu)	8.8	Betel leaves		5.7
Jowar (Cholam)	6.2	Jaggery		11.4
Ragi	5.4			
Rice, raw, milled	2.8			
Rice, raw, home-pounded	3.6	*Nuts and oilseeds*		
Rice, raw, husked	4.5	Cashewnut		5.0
Rice, parboiled, milled	3.2	Gingelly (sesame) seeds		10.5
Wheat, whole	5.3	Groundnut		1.6
Pulses		*Green leafy vegetables*		
Bengal gram dhal	8.9	Amaranth, tender		21.4
Black gram dhal	9.8	Coriander leaves		10.0
Green gram dhal	8.4	Fenugreek leaves		16.9
Horse gram	7.6	Mint		15.6
Peas, dried	4.4	Spinach		5.0
Red gram dhal	8.8			
Soya bean	11.3			

	Iron (mg./100g.)		Iron (mg./100g.)
Other vegetables		*Flesh foods*	
Bitter gourd	9.4	Egg, hen's	2.1
Cluster beans	5.8	Fish	2.3
Tomato, green	2.4	Liver, Sheep	6.3
		Mutton	2.5

Note: Milk is a poor source of iron.

IODINE

Iodine is a constituent of *thyroxine*, the active principle of *thyroid gland.* Thyroid gland plays an important part in energy metabolism and in the growth of the body. Iodine is required for the formation of *thyroxine*.

Iodine deficiency in human beings

If sufficient iodine is not taken in the diet, enlargement of the thyroid gland takes place resulting in the disease called *goitre.* In India *goitre* occurs in persons living in the hilly regions along the foot of the Himalayas.

Important sources of iodine

Iodine occurs only in small amounts in common foods. The iodine content of foods depends on the iodine content of the soil. Foods grown in hilly regions contain less iodine than those grown in the plains. Crude common salt (prepared from sea water) and sea fish are the richest natural sources of iodine.

Iodine requirements

Iodine requirement of adults is about 0.2 mg. daily. This is normally supplied by well-balanced diets and drinking water, except in hilly regions where the food and water may be deficient in iodine.

SODIUM CHLORIDE

All minerals, except sodium chloride, are usually present in sufficient amounts in a balanced diet. Sodium chloride is the only mineral which is taken in more or less pure form in addition to the amount present in foods.

Effects of sodium chloride deficiency

Men doing hard work in hot humid climates and consuming a diet deficient in sodium chloride suffer from '*heat cramps*', i.e., intense and painful contractions of skeletal muscle. This is due to sodium chloride deficiency produced by loss of sodium chloride from the body by excessive sweating. The loss of sodium chloride may be as much as 10 to 20 g. per 8 hours of hard work. *Heat cramps* may be prevented by drinking water containing 0.2 to 0.5 per cent sodium chloride.

Sodium chloride requirements

Sodium chloride requirements depend on (1) Climate (2) Occupation and (3) Physical activity. The approximate sodium chloride requirements of persons living *in the tropics* are given below:

	Sodium Chloride (*g./day*)
Adults	
Light work	.. 10-15
Hard work	.. 15-20
Very hard work	.. 25-30
Children	.. 5-10
Adolescent boys and girls	.. 10-25

POTASSIUM

Potassium is contained mainly in the cells and only small amounts are present in the extra-cellular fluids. It plays an important role in maintaining the osmotic pressure of the body fluids, acid-base balance of the body and normal heart action. Potassium deficiency does not occur under normal conditions but cases of

hypokalaemia characterised by muscular weakness and lethargy, have been reported in kwashiorkor, starvation, dehydration, severe burns and crushing injuries. Potassium is found in almost all foods. A balanced diet will provide adequate intake.

MAGNESIUM

Magnesium appears to be important in certain enzymatic reactions, such as breakdown of glycogen and also in calcium and phosphorus metabolism. It is found in large quantities in milk and other foods, and deficiency is not likely to occur. Experimentally induced deficiency in animals is characterised by stunted growth and convulsions.

FLUORINE

Fluorine is required in small amounts for the prevention of dental caries. If present in excessive amounts in drinking water, a disease known as *fluorosis*, may occur.

The first sign of *fluorosis* is usually seen in the teeth as mottled enamel. The enamel gets eroded, has a chalky appearance, and the teeth become brittle. In adults, excess of fluorine causes loss of appetite, sclerosis of the bones of the spine, pelvis and limbs, and calcification of ligaments and tendinous insertions of muscles.

COPPER

All tissues in the animal and human body contain traces of copper. In certain regions in Scotland and Australia, deficiency of copper in soil and grass causes a disease in lambs known as 'Swayback', characterised by demyelination of the spinal cord. Copper deficiency affects the absorption of iron. Traces of copper are normally present in the blood in combination with an alpha 2-globulin to form a blue-coloured protein known as *ceruloplasmin*. A disorder of copper metabolism may be involved in Wilson's disease.

COBALT

The discovery that vitamin B_{12} contains 3 per cent of cobalt established that this metal is essential for man. It had been known previously that cattle and sheep which grazed on pastures deficient in cobalt developed a wasting disease known as 'pine', characterised by loss of appetite, debility, emaciation and anaemia. Traces of cobalt are present in a great variety of foods, and it is therefore unlikely for cobalt deficiency to occur in the human. Cobalt salts consumed in excess have been found to be harmful.

ZINC

The major part of body zinc is found in the enzyme carbonic anhydrase which is present in the erythrocytes. Traces of zinc are also present in other tissues, particularly in the pancreas, in combination with insulin. Most of the human diets contain adequate amounts of zinc.

MANGANESE

Traces of manganese have been shown to be present in human blood and also in the liver. Manganese deficiency has been produced in many experimental animals. It is required for the activity of several enzymes like alkaline phosphatase, arginase, etc. Since all foodstuffs contain traces of manganese, deficiency of this mineral is not likely to occur.

VIII. DIGESTION, ABSORPTION AND METABOLISM

The foods that we eat have to undergo profound physical and chemical changes during digestion before they are absorbed and utilised by the body.

Digestion in the mouth

In the mouth, food is thoroughly mascerated by mastication and the grinding action of the teeth. Simultaneously it is moistened by the saliva which acts also as a lubricant to aid swallowing. The saliva contains ptyalin, a starch splitting enzyme which hydrolyses starch into dextrins and maltose. The tongue possesses taste buds which are stimulated by agreeable foods and thus serve as stimulants for continued food intake.

Digestion in the stomach

After mastication the food enters the stomach through the act of swallowing via the oesophagus. In the stomach the first portions of the food mass remain in the centre so that the salivary digestion may continue in alkaline medium while the later portions accumulate in the outer layer. Subsequently, by means of the contractions of the stomach the food is exposed to digestion by the acidic gastric juice. An average semisolid or solid meal remains in the stomach for three to four and a half hours while liquids remain for shorter periods only.

The mucous membrane of the stomach secretes hydrochloric acid, mucin, and a number of enzymes: (1) pepsin which digests proteins, (2) rennin, which curdles milk, and (3) gastric lipase, which has a relatively weak fat splitting effect.

The most important digestive action of the stomach is the splitting of proteins which takes place only in acid medium (optimum pH 1.5). The hydrochloric acid secreted by the stomach aids this digestion. Proteins are split into polypeptides, proteoses and peptones which are intermediate stages in protein digestion.

Mucin acts as a lubricant and also protects the gastric mucous membrane against the action of hydrochloric acid. Hydrochloric acid also helps in destroying or inhibiting bacteria which may be present in the food. The partially digested food then enters the small intestines by means of the contractions and propelling action of the stomach.

Intestinal digestion

The most important digestive processes take place in the small intestines and the resulting end products are absorbed into the blood stream via the intestinal mucous membrane.

By means of the contractions of the intestines the food is brought in intimate contact with the several digestive juices and their enzymes secreted by the pancreas, liver and intestines.

The pancreas secretes pancreatic juice which contributes the following enzymes:

1. Trypsin, and chymotrypsin which split proteins into polypeptides.
2. Carboxypeptidase which hydrolyses polypeptides into peptides and amino acids.
3. Pancreatic amylase which splits starch into dextrins and maltose.
4. Pancreatic lipase which hydrolyses fats into glycerol and fatty acids.

The liver cells secrete bile which accumulates in the gall bladder and is released into the intestines as and when needed. Fatty foods serve to stimulate the gall bladder which discharges its contents into the

intestines. Bile contains no enzyme but contains bile salts, bile pigments, lecithin and cholesterol. The bile salts help to emulsify fat in the food thereby reducing it to minute particles so that pancreatic lipase can act on them.

The intestinal juice (*succus entericus*) is secreted by the glands in the intestinal mucous membrane. This is alkaline in reaction and contains the following digestive enzymes.

(1) Peptidases which hydrolyse polypeptides into amino acids.

(2) Phosphatases which hydrolyse glycerophosphates and other phosphorilated compounds.

(3) Carbohydrases which hydrolyse disaccharides like maltose, lactose and sucrose liberating simple sugars like glucose, galactose and fructose.

(4) Intestinal lipase, which splits fats.

ABSORPTION

Practically all the nutrients are absorbed in the small intestines. Except alcohol no other nutrient is absorbed in the stomach. Gastric and intestinal digestion breaks down carbohydrates into simple sugars like glucose, fats into glycerol and fatty acids and proteins into amino acids. These end products of digestion are of very small molecular size and are absorbed into the blood stream through the intestinal mucous membrane. The fat is absorbed through the lymphatic vessels known as lacteals and are collected by the main lymphatic vessel of the body known as the thoracic duct which discharges its contents directly into one of the big blood vessels near the neck. Sugars, amino acids and some of the fatty acids enter the portal vein and pass through the liver into the blood stream for utilisation by the various organs of the body.

The unabsorbed residue is passed on into the large intestine which serves as a reservoir. Here the normal bacterial flora degrade some of the food constituents

that have resisted digestion. Also some of the electrolytes and water which are secreted by the small intestines are reabsorbed here. The bacterial flora also synthesise certain vitamins of the B-complex, vitamin K and folic acid. The final waste product composed mostly of cellular material from the intestines, bacteria, secretions and excretions of the intestines and unabsorbed residue is passed out as faeces.

METABOLISM OF CARBOHYDRATES FATS AND PROTEINS

The changes which carbohydrates, fats and proteins undergo in the body after digestion and absorption are included under the term *metabolism.* The metabolism of carbohydrates, fats and proteins is briefly outlined below:

Metabolism of carbohydrates

The carbohydrates of the food are absorbed in the form of monosaccharides i.e., glucose, fructose and galactose from the intestinal tract. They pass through the portal vein to the liver. In the liver, glucose, fructose and galactose are converted into the polysaccharide glycogen and stored in that organ. The glycogen is being continuously split into glucose which is present in the blood. The liver thus functions as a reservoir of carbohydrates and helps to maintain the blood sugar level fairly constant. Glucose is oxidised in the cells of different tissues liberating the energy required for the normal functioning of the body and for physical work. Carbohydrates consumed in excess of the requirements are converted into fats and stored in the adipose tissue.

Metabolism of fats

Fat absorbed from the intestines after digestion passes through the general circulation and the liver to

different tissues. A part of the fat is stored in the adipose tissue. Fat is being oxidised in the cells of different tissues mainly as a source of energy. It is also used in the formation of different tissue lipids. Fat consumed in excess of the body needs is mainly stored in the adipose tissue.

Metabolism of proteins

The amino acids released from the proteins after digestion are absorbed from the intestines. They pass through the portal circulation to the liver and then through the general circulation to different tissues. A greater part of this is used in the synthesis of tissue proteins in the growing animals and children and also in replacing the inevitable loss of tissue proteins taking place in the animal and human body. A small part is also utilised in the synthesis of enzymes, hormones etc. The unused dietary amino acids and a part of the amino acids released from the breakdown of tissue proteins are oxidised in the liver. The main nitrogenous compounds formed i.e., urea, uric acid and creatinine are excreted in the urine. The non-nitrogenous carbon residue is converted into carbohydrate or fat and oxidised in the cells yielding energy.

EXCRETION

As a result of metabolism certain degradation products accumulate in the cells and organs and these will have to be eliminated from the body. Several organs are involved in this process of elimination. The tissue waste products are carried by the blood to these organs for elimination. The sweat glands eliminate water, sodium chloride and small amounts of other waste products. The kidneys eliminate water, sodium chloride and other minerals, urea, uric acid, ammonium salts and creatinine. The lungs excrete carbon dioxide and water. The large intestines eliminate undigested food residue, water and certain unabsorbed minerals.

IX. THE NUTRITIVE VALUE OF FOODSTUFFS

Foods may be broadly classified into 10 groups based on their nutritive value: (1) Cereals and millets (2) Pulses (3) Nuts and oilseeds (4) Vegetables: (*a*) leafy vegetables (*b*) Roots and tubers and (*c*) Other vegetables (5) Fruits (6) Milk and milk products (7) Eggs (8) Meat, fish, liver etc. (9) Fats and oils and carbohydrate foods and (10) Condiments and spices. The nutritional significance of the different groups of foods is briefly described below:

1. Cereals and millets

Cereals and millets constitute by far the most important of foodstuffs throughout the world. Their protein content varies from 6-12 per cent. In Africa, South America, India and several Asian countries, they supply 70 to 80 per cent of the calories and proteins in the diets of the people. They are also important sources of B-vitamins and minerals in such diets. The chemical composition of some of the important cereals and millets is given in Table 78. All cereals except ragi, are poor to moderate sources of calcium. Rice is the poorest of all in calcium content. *Ragi is one of the richest sources of calcium.* Cereals do not contain vitamins A, D, B and C. Yellow maize, however, contains fair amounts of carotene (Provitamin A).

2. Pulses

Pulses are rich in proteins containing about 20-25 per cent. They are also good sources of B-vitamins and minerals. They contain only traces of carotene but do not contain vitamins D and B_{12}. Puffed Bengal gram dhal contains proteins of fairly high biological value and is a good supplement to the diets of children.

Dried pulses do not contain any vitamin C but germinated pulses are good sources of vitamin C. Tender pulses like green peas, green Bengal-gram and green field bean are also good sources of vitamin C. The chemical composition of some important pulses is given in Table 78.

3. Nuts and oilseeds

Nuts and oilseeds are, in general, (except coconut) rich sources of protein, containing about 18-28 per cent. They are also rich sources of fat. Nuts and oil seeds are good sources of minerals and B-vitamins. Gingelly (sesame) seed is particularly rich in calcium. Nuts and oilseeds do not contain vitamins A, D, C and B_{12}. In view of their richness in protein and fats, they can be used for preparing vegetable milk substitutes (see chap. XV) which can be given to infants over 6 months and to young children.

4. Vegetables

(*a*) *Green leafy vegetables:* Green leafy vegetables are very rich sources of *carotene* (Provitamin A). They are also good sources of *calcium*, *riboflavin*, *folic acid* and *vitamin C*. The daily diet should include at least 2-4 ounces of green leafy vegetables depending upon the age of the subject. They are the cheapest among the protective foods.

(*b*) *Roots and tubers:* The important foods in this group are potato, sweet potato (white and yellow flesh), tapioca, carrot, elephant yam and colocasia. Roots and tubers are good sources of *carbohydrates*. Some of them are also good sources of vitamin C. Carrots and yellow flesh variety of sweet potato are also rich sources of *carotene* (Provitamin A), but potato, white flesh variety of sweet potato and tapioca do not contain carotene. Potato is moderately rich in proteins while sweet potato and tapioca are poor sources. *Nevertheless, all the three foods can serve as partial*

substitutes for cereals in the diet: In view of the high yield of calories per acre, sweet potato and tapioca are the cheapest among the energy yielding foods (See Chapter XII—Subsidiary foods).

(*c*) *Other vegetables:* This group includes all vegetables other than those included in the above category. Some of them are fair sources of vitamin C and minerals.

5. Fruits

Fruits, in general, are good sources of vitamin C. Some of them (mango and papaya) are also moderately rich sources of carotene (Provitamin A). Indian gooseberry (*Amla*) and guava are very rich sources of vitamin C. Other good sources of vitamin C are tomato, citrus fruits, papaya, cashew fruit and pineapple. Apple and banana are only fair sources of vitamin C.

6. Milk and milk products

Milk is universally regarded as an ideal food for nourishing infants and young children. It is also a good supplementary food in the diets of adults. *Milk is the most complete of all foods, containing the different nutrients in the proper proportion.* It is, however, deficient in iron and contains only small amounts of vitamins C and D. The chemical composition of milk of different mammals and of some milk products is given in Table 78.

It is evident that the milks of cow, buffalo and goat are richer in all dietary essentials (except lactose) than human milk. Buffalo's milk is richer in fat than cow's or goat's milk. *Sour curd* prepared from milk by seeding with *lactobacillus* contains some lactic acid. The nutritive value of the curd is similar to that of the milk.

Whole milk powder: Whole milk powder is about 8 times richer than fresh milk in all nutrients except vitamin C which is mostly destroyed during drying. When reconstituted with 7 times its weight of water, reconstituted milk has almost the same composition as that of fresh milk.

Skimmed milk powder: Skimmed milk powder is prepared from milk from which the fat has been removed. Hence it contains very little fat and only negligible quantities of vitamin A and D. It is richer than whole milk powder in proteins, B-vitamins and minerals. *Since it is deficient in fat and vitamins A and D, it is not suitable for feeding infants.* It can, however, be used as a supplement to the diets of children and adults.

Sweetened condensed milk: This is about 2½ times richer than fresh milk and contains in addition about 45 per cent cane sugar. *It is not suitable for feeding infants* as it contains too much of sugar. It may, however, be given as a supplement to the diets of children and adults.

7. Eggs

Hen's egg is a highly nutritious food containing about 13 per cent protein of high biological value and 13 per cent fat (rich in lecithin). It is also a rich source of vitamin A and B-vitamins. It is a fair source of vitamin D but does not contain any vitamin C. The chemical composition of duck's egg is similar to that of hen's egg. Duck's egg, however, contains a substance called 'trypsin inhibitor' which lowers the nutritive value of the proteins and hence should not be consumed *in the raw state.* The 'trypsin inhibitor' is destroyed when the egg is boiled. *Egg white* contains only protein and B-vitamins while *egg yolk* contains protein, fat (rich in lecithin) and vitamins A, B-complex and D. The chemical composition of hen's and duck's egg is given in Table 78.

8. Liver, meat and fish

Liver: Liver is rich in proteins (18-20 per cent) of high biological value and vitamin A and B-complex. *It is the richest natural source of vitamin B_{12}—the anti-pernicious anaemia factor.*

Meat: Meat is rich in proteins (18-22 per cent) of high biological value. It is a fair source of B-vitamins. It does not contain any vitamin A, C or D.

Fish: Fish is rich in proteins (18-22 per cent) of high biological value. It is a fair source of B-vitamins. Fatty fish contain some vitamin A and D. Large fish are rich in phosphorus but are deficient in calcium. *Small fish, eaten with bones, are good sources of calcium.*

9. Fats and oils and carbohydrate foods

Fats and oils: Fats and oils serve mainly as sources of energy. *Ghee, butter and vanaspati (hydrogenated groundnut oil) contain about 750 I. U. of vitamin A per ounce.* The common vegetable oils and fats consumed in India do not contain carotene or vitamin A. Vanaspati and all vegetable oils are good sources of vitamin E.

Carbohydrate foods: The carbohydrate foods commonly used are cane sugar, jaggery, glucose, honey, syrup, custard powder, arrowroot flour and sago. They serve mainly as a source of energy. Honey and jaggery contain, in addition to sugars, small quantities of minerals and vitamins.

10. Condiments and spices

Condiments and spices are commonly used to enhance the palatability of foods. The essential oils present in them have carminative properties and may aid digestion by stimulating the appetite and the secretion of digestive juices. Certain spices, namely garlic and asafoetida, contain active principles which correct digestive disorders by inhibiting the growth of putrefactive bacteria in the intestinal tract.

X. NUTRITIVE VALUE OF WHEAT AND WHEAT PRODUCTS

The wheat grain consists of the following parts (1) the endosperm which makes up about 85 per cent of the whole grain (2) the pericarp and aleurone layer together constituting the bran and making up about 13 per cent of the grain and (3) the germ which makes up about 2 per cent of the whole grain. Whole wheat flour, white flour and semolina (*Suji* or *Rava*) are widely consumed in India. The chemical composition of the three products is given in Table 19.

Table 19. **Chemical composition of wheat products (Values per 100 g.)**

	Protein (g)	Fat (g)	Fibre (g)	Carbo-hydrate (g)	Calcium (g)	Phosphorus (g)	Iron (mg)	Vitamin B_1 (mg)	Nicotinic acid (mg)
Whole wheat flour	11.8	1.5	1.2	71.2	0.050	0.320	5.3	0.54	5.0
White flour (70-72% extraction)	10.2	0.8	0.2	74.8	0.016	0.106	1.5	0.12	1.2
Semolina (*Suji*)	10.4	0.8	0.2	74.8	0.016	0.102	1.6	0.12	1.2

Whole wheat flour: Whole wheat flour is obtained by grinding cleaned wheat in a flour mill. It contains the germ and the bran. It is richer than white flour in proteins, vitamin B_1, nicotinic acid and other B-vitamins.

White flour (Maidha flour): White flour is obtained by milling whole wheat so as to remove the bran and the germ. White flour consists mostly of the endosperm of wheat and is practically free from the bran and the

germ. It usually represents about 70-75 per cent extraction. It is a poor source of B-vitamins.

Semolina (*Suji* or *Rava*): Semolina consists mostly of the endosperm. Its nutritive value is similar to that of white flour. It is a poor source of B-vitamins as compared to whole wheat flour.

Bread

Bread is made from the dough of wheat flour to which salt and sugar have been added. The dough is allowed to ferment after the addition of yeast under controlled conditions and then baked. During baking, the bread rises due to the escape of carbon dioxide, yielding a porous structure.

White bread: White bread is prepared from white flour. It is easily digestible due to its low fibre content but is a poor source of B-vitamins.

Brown bread: Brown bread is prepared from whole wheat flour. It is a richer source of B-vitamins than white bread. It contains a fair amount of fibre.

The chemical composition of white and brown breads is given in Table 20.

Table 20. **Chemical composition of bread**
(Values per 100 g.)

	Protein (g)	Fat (g)	Fibre (g)	Carbo-hydrate (g)	Calories	Calcium (g)	Iron (mg)	Vitamin B_1 (mg)	Nicotinic acid (mg)
White bread	7.8	0.7	0.2	51.9	245	0.011	1.1	0.04	0.7
Brown bread	8.8	1.4	1.2	49.0	244	0.018	2.2	0.21	2.5

XI. THE EFFECT OF MILLING, WASHING AND COOKING ON THE NUTRITIVE VALUE OF RAW AND PARBOILED RICE

The effect of milling on the nutritive value of raw rice

The rice grain is composed of three parts (*a*) the outer layer or pericarp (*b*) the inner starchy kernel or endosperm and (*c*) the germ or embryo. As a result of milling of rice, the pericarp and the germ are removed. These two parts are rich in vitamins of the B-complex. The chemical composition of husked, undermilled (or home-pounded) and highly milled rice is given in Table 21.

Table 21. **Chemical composition of rice**

	Protein%	Calcium%	Phosphorus%	Iron (mg) %	Vitamin B_1 (mg) %	Nicotinic acid (mg)%
Raw, husked rice ...	7.7	0.015	0.368	4.0	0.40	3.5
Raw, undermilled or home-pounded rice (about 7% polishings removed) ...	7.2	0.013	0.146	2.2	0.22	2.2
Raw, milled rice (about 14% polishings removed) ...	7.0	0.010	0.110	2.0	0.11	1.0

The above values show that

(*a*) Milling of raw rice removes a greater part of vitamin B_1 and nicotinic acid (and also other B-vitamins) present in the rice.

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(*b*) Since raw milled rice is a poor source of B-vitamins, undermilled or home-pounded rice should be consumed in preference to milled rice.

Effect of parboiling on the nutritive value of rice

Parboiling of paddy has been practised in India for many centuries. During the process of parboiling, the B-vitamins present in the pericarp and the germ penetrate into the endosperm and are not lost during milling. It is important to note that *parboiled milled rice is a rich source of vitamin B_1 and nicotinic acid in contrast to raw milled rice which is a poor source.*

The vitamin B_1 and nicotinic acid contents of parboiled, undermilled and milled rice samples are given below:

	Vitamin B_1 (*mg/100g.*)	*Nicotinic acid* (*mg/100g.*)
Parboiled undermilled rice (7% polishings removed)	0.32	3.5
Parboiled milled rice (14% polishings removed)	0.24	2.4

The process of parboiling at present adopted by the industry yields a rice having an off-flavour. The Central Food Technological Research Institute has made improvements in the process of parboiling for eliminating the off-flavour. The improved process consists in soaking the paddy in hot water at 70°-75°C for 4 hrs. and then steaming the soaked paddy. The new process is completed in 5 hrs. as compared with the old process which takes several days.

In view of its higher vitamin B-content, consumption of parboiled rice in place of raw rice is highly desirable.

Effect of washing and cooking on the vitamin B_1 and nicotinic acid contents of rice

Rice is generally washed and then cooked in excess of water. The gruel present in cooked rice is usually drained off. These procedures cause a marked loss of

vitamin B_1 and nicotinic acid (and other B-vitamins) in the case of home-pounded and milled raw rice. *The losses of B-vitamins are very much less in the case of home-pounded and milled parboiled rice.* The results are given in Table 22.

Table 22. **Effect of washing and cooking on vitamin B_1 and nicotinic acid contents of raw and parboiled rice**

(Values per 100 g. original rice)

Treatment	Parboiled home-pounded rice		Parboiled milled rice		Raw home-pounded rice		Raw milled rice	
	Vit. B_1 (mg)	Nicotinic acid (mg)	Vit. B_1 (mg)	Nicotinic acid (mg)	Vit. B_1 (mg)	Nicotinic acid (mg)	Vit. B_1 (mg)	Nicotinic acid (mg)
Original rice ...	0.32	3.5	0.24	2.4	0.22	2.2	0.11	1.0
Washed rice	0.29	3.2	0.22	2.1	0.10	1.1	0.07	0.6
Washed and cooked* rice	0.16	1.9	0.13	1.5	0.06	0.5	0.04	0.3

* Gruel removed

It is evident that *washed and cooked raw milled rice is a very poor source of vitamin B_1 and nicotinic acid while washed and cooked parboiled milled rice is a good source of the two vitamins.*

XII. SUBSIDIARY FOODS

Tapioca, potato, sweet potato and low-fat groundnut flour

In view of the shortage in the supply of cereals in the country, there is a need to supplement the diets by other foods rich in calories. *These foods should be such that they give larger yields of calories per acre than cereals and can be cultivated easily both as a kitchen garden crop and on a field scale.* The most important of such foods are the roots and tubers such as tapioca, sweet potato and potato. In view of the fact that these foods contain less proteins than cereals, they could serve mainly as a source of energy in the diet. At the same time, a food, rich in protein should be included in the diet to meet the protein needs. Investigations conducted at the Central Food Technological Research Institute, have shown that specially prepared low-fat groundnut flour forms a good supplement to diets based on tapioca and sweet potato flours and a mixture of 75 parts of tapioca flour and 25 parts of groundnut flour (known as Mysore flour) has a nutritive value equal to that of common cereals. The chemical composition of tapioca, sweet potato, potato and low-fat groundnut flour is given in Table 23.

Utilisation of tapioca, sweet potato and potato as partial substitutes for cereals

Tapioca, sweet potato and potato are being consumed in different parts of the world as partial substitutes for cereals. Investigations carried out at the Central Food Technological Research Institute have shown that 25 per cent of cereals in our diets could be replaced by tapioca flour or sweet potato flour without affecting the overall nutritive value of the diets. A daily consumption of 8 ounces of fresh roots and tubers will help considerably in making up the calorie deficiency in poor Indian diets;

such a step will also help to overcome the shortage of cereals in the country.

Utilisation of a mixture of tapioca flour and groundnut flour (Mysore flour) as partial substitute for cereals

A blend of 75 parts of tapioca flour and 25 parts of groundnut flour (known as Mysore flour) can be used as a partial substitute for cereal flours. Experiments on school children have shown that 50 per cent of the cereals in the diet can be replaced by Mysore flour without affecting the growth and health of children. The flour can be used in admixture with wheat flour for the preparation of *chapatis* and *purees*. Gruel prepared from Mysore flour has also been used during 1953 for the large scale feeding of people in food scarcity areas in Madras State.

Table 23. **Chemical composition of subsidiary foods**
(Values per 100 g.)

Name of foodstuff	Protein (g)	Fat (g)	Carbohydrate (g)	Calorific value	Calcium (g)	Phosphorus (g)	Thiamine (mg)	Riboflavin (mg)	Nicotinic acid (mg)
Potato, fresh	1.6	0.1	22.9	99	0.01	0.03	0.10	0.01	1.2
Sweet potato, fresh	1.2	0.3	31.0	132	0.02	0.05	0.08	0.04	0.7
Tapioca, fresh	0.7	0.2	38.7	159	0.03	0.04	0.04	0.02	0.5
Tapioca flour	1.7	0.5	85.5	353	0.06	0.08	0.12	0.04	1.0
Groundnut flour	52.7	8.9	21.8	378	0.07	0.50	0.95	0.20	19.5
Mysore flour*	13.8	2.7	69.8	359	0.06	0.18	0.31	0.07	5.4
Tapioca macaroni	10.5	1.9	73.8	354	0.05	0.14	0.22	0.07	3.7
Rice, raw milled	7.0	0.6	79.3	350	0.01	0.11	0.11	0.03	1.0

* A mixture of tapioca flour (75 parts) and groundnut flour (25 parts).

Tapioca macaroni

As a result of work done at the Central Food Technological Research Institute, a process for the preparation

of tapioca macaroni from a blend of tapioca flour (60 parts), groundnut flour (15 parts) and semolina (25 parts) has been standardised. The chemical composition of tapioca macaroni as compared with that of natural rice is given in Table 23. The data show that tapioca macaroni is richer than natural rice in protein, calcium and B-vitamins. Feeding experiments with animals have shown that the growth promoting value of a poor vegetarian diet based on tapioca macaroni is about twice that obtained with rice diet.

Feeding experiments on children have shown that when rice in poor rice diet is replaced completely by tapioca macaroni, the growth and health of children are not affected. The retention of nitrogen, calcium and phosphorus on the tapioca macaroni diet is greater than that observed on the rice diet.

XIII. BEVERAGES

A large variety of beverages are consumed by man. The commonly consumed beverages may be broadly grouped under the following heads: (1) Coffee, tea and cocoa, (2) Fruits juices and squashes, (3) Miscellaneous beverages such as coconut water, Neera, sweetened carbonated drinks, etc. and (4) Alcoholic drinks. A brief account of the different beverages is given in this chapter.

1. COEFEE, TEA AND COCOA

Coffee, Tea and Cocoa are the beverages widely used all over the world. They are invigorating drinks and remove a sense of exhaustion, due to the stimulating action of substances like *caffeine* or *theobromine* present in them.

Coffee

The stimulating effect of coffee is due mostly to its content of *caffeine*. Coffee also contains some essential oils which are pleasing to the taste. *Caffeine* stimulates gastric secretion and hence may aid digestion to a certain extent. It has a delaying action on the emptying time of the stomach and hence it allays a sense of hunger.

Nutritive value

The chemical composition of a cup of coffee containing 6 ozs. of decoction, 2 ozs. of milk and 15 grams of sugar is given in Table 24.

Effects of excess consumption

Excessive consumption of coffee is likely to be harmful, due to high intake of *caffeine*. *Caffeine* in excess produces insomnia and causes irritability and rapid heart action. It also causes increased excitability of the nervous system, particularly in the very young and the very old.

Tea

The stimulating effect of tea also is due to its *caffeine* content.

Nutritive value

Since very little milk goes into the making of a cup of tea, its nutritive value is far less than that of coffee. The nutritive value of one cup of tea containing 7 ozs. of decoction, 1 oz. of milk and 15 grams of sugar is given in Table 24.

Excessive consumption of tea has the same effects as excessive consumption of coffee.

Cocoa

Cocoa contains a substance called *theobromine* which has stimulating properties like *caffeine*. Cocoa by itself has a higher protein content than coffee or tea (without milk). Cocoa gives a pleasant flavour to milk. Since more milk goes into the making of a cup of cocoa than of coffee or tea, a cup of cocoa has a higher nutritive value than a cup of coffee or tea. The chemical composition of one cup of cocoa containing 8 ozs. of milk 6 g. of cocoa and 15 g. of sugar is given in Table 24.

Table 24. **The chemical composition of coffee, tea and cocoa**
(Values per cup)

	Coffee	Tea	Cocoa
Protein (g)	1.8	0.9	7.2
Fat (g)	2.2	1.1	8.8
Carbohydrate (g)	17.8	16.4	26.2
Calcium (g)	0.068	0.034	0.27
Phosphorus (g)	0.050	0.025	0.20
Vitamin A (I.U.)	102	51	408
Calories	98	79	213

Taken in moderation, these beverages act as mild stimulants and add to the nutritive value of the diet, because of the milk and sugar taken along with them.

2. FRUIT BEVERAGES

The beverages based on fruits include fruit juices, squashes, cordials.

Fruit juices

The fresh juices extracted from the various fruits contain mainly sugars and small quantities of vitamins and minerals. The acid taste is due to the presence of organic acids. The chemical composition of some fruit juices is given in Table 25.

Fruit juice squashes

Squashes are prepared by the addition of sugar, organic acids and preservatives to freshly expressed fruit juices. Squashes are usually diluted with water before consumption (Table 25).

Fruit juice cordials

Fruit juice cordials differ from the fruit juice squashes in that the suspended fruit pulp has been removed. They are usually diluted with water before consumption.

3. MISCELLANEOUS BEVERAGES

Coconut water

The water present in tender coconut is a popular drink all over India. It contains about 6 per cent sugars and small quantities of vitamins and minerals (Table 25).

Sweet toddy (Neera)

The freshly drawn up sap of different palms usually preserved by the addition of calcium hydroxide is a popular drink in some parts of India. It contains about 14 per cent sugars and small quantities of vitamins and minerals (Table 25).

Sugar-cane juice

Freshly expressed sugar cane juice with added lemon juice is commonly consumed in some parts of India.

Table 25. **The Nutritive Value of some beverages** (values per 100 g.)

Name of beverage	Water (g)	Fat (g)	Total carbo-hydrates (g)	Calcium (mg)	Iron (mg)	Carotene (Pro-vitamin A) (μg)	Thiamine (mg)	Riboflavin (mg)	Vitamin C (mg)	Calorific value
Fruit juice										
Apple juice ...	85.9	...	13.8	6	0.5	4	0.02	0.02	1	55
Grape juice ...	85.3	...	13.7	8	0.3	20	0.02	0.02	35	55
Mango juice ...	84.2	...	14.6	12	0.5	1500	0.03	0.02	49	44
Orange juice ...	87.5	...	11.0	19	0.2	190	0.03	0.02	49	44
Pine apple juice ...	86.2	...	13.0	15	0.5	80	0.03	0.02	9	52
Tomato juice ...	93.5	...	4.3	7	0.4	1050	0.03	0.02	16	17
Dilute squash										
Orange squash ...	83.2	...	15.2	5	0.2	20	0.01	0.01	6	61
Lemon squash ...	83.4	...	15.0	7	0.2	...	0.01	0.01	5	60
Pineapple squash ...	82.9	...	15.2	6	0.2	50	0.01	0.01	5	61
Mango squash ...	82.9	...	15.6	8	0.2	500	0.01	0.01	6	62
Miscellaneous beverages										
Coconut water ...	93.9	...	5.9	10	0.1	...	0.01	0.01	2	24
Coconut milk ...	46.3	46.3	8.3	20	0.4	...	0.05	0.03	2	405
Neera (sweet toddy) ...	84.7	...	14.3	40	1.0	...	0.02	0.02	13	57
Soft drinks, corbonated (cold and other sweet drinks) ...	88	...	12	...	...	...	...	...	...	48
Sugar-cane juice ...	90.2	...	9.1	10	1.1	...	0.02	0.02	5	36

It contains about 9 per cent sugar and small amounts of vitamins and minerals (Table 25).

Coconut milk

Coconut milk is a milk-like emulsion expressed from freshly grated mature coconut kernel with the addition of small amounts of water. It is rich in fat (41 per cent) and contains small amounts of protein (3 per cent), vitamins and minerals and fair amounts of carbohydrates (8 per cent) (Table 25).

Sweetened carbonated beverages

The sweetened carbonated beverages contain about 10-15 per cent sugar.

Flavoured syrup (Sharbat)

These consist of sugar syrup flavoured with artificial flavouring agents. They are usually diluted with water before consumption.

4. ALCOHOLIC BEVERAGES

A large variety of alcoholic beverages are consumed by human beings in many countries. They contain varying amounts of alcohol. Alcohol in moderate dozes stimulates gastric secretion and is absorbed and serves as a source of energy. Alcohol is a depressent of the brain and excessive amounts of alcohol causes severe brain depression and inco-ordination of movements and loss of consciousness. The alcohol content of some beverages is given below:

Toddy and beer contain appreciable amounts of B-vitamins.

Alcohol content of Alcoholic Beverages

	Alcohol (%)
Beers	.. 3.5 to 5.0
Toddy	.. 3.5 to 7.0
Wines	.. 10-16
Wines fortified with spirit	.. 17-23
Spirits (Brandy, gin, rum and whisky)	.. 35-45

XIV. EFFECT OF COOKING ON THE NUTRITIVE VALUE OF FOODS

The object of cooking is three-fold: (*i*) *Aesthetic* e.g., to improve its appearance (*ii*) *Appetising* e.g., to develop in it new flavours and (*iii*) *Hygienic* e.g., to destroy harmful organisms present and to render the food more digestible.

Cooking methods

Important methods of cooking are the following: (1) Boiling in water (2) Steaming (3) Baking (4) Roasting and (5) Frying.

Effect of cooking on the various nutrients

Carbohydrates: Cooking is essential for proper digestion of starch which is an important source of calories in the diet. When heat is applied in any method of cooking, the starch granules swell and burst and become gelatinised, in which state they are almost completely digested and absorbed. Raw starch as such (uncooked flour, potato etc.) is enclosed in starch granules which are resistant to the human digestive juices.

Fat: Cooking under ordinary household conditions has very little effect on fats but there is some evidence to show that on prolonged heating (e.g., when used for frying over a number of days) fats become slightly toxic as revealed by animal experiments.

Proteins: Application of heat to proteins causes coagulation and shrinking. Moderately cooked protein is more easily digested than raw protein. But excessive exposure to heat as in roasting will eventually reduce appreciably the nutritive value of proteins. *Certain foods like pulses show marked improvement in nutritive value as a result of heat treatment.* They contain substances which hinder digestion of proteins by the enzyme

trypsin. These substances (trypsin inhibitors) are destroyed by heat during cooking, thus bringing about an improvement in the nutritive value of proteins.

VITAMINS:

Vitamins A & D: As they are insoluble in water, no loss occurs by the discarding of cooking water. There is only slight destruction of vitamin A and carotene when foodstuffs are cooked in water; but on frying or roasting, considerable loss occurs.

Thiamine (*Vitamin* B_1): Loss of vitamin B_1 in foods occurs in two ways: (*a*) its destruction during cooking (*b*) its dissolution in the cooking water. Hence the amount destroyed during cooking varies. Discarding the cooking water accounts for a loss of nearly 20-50 per cent depending on the quantity of water used in cooking. If soda is added to dhal during cooking, most of this vitamin is destroyed. *So cooking soda should not be added to pulses and dhals for improving their cooking quality.*

Ascorbic acid (*Vitamin C*)*:* The loss of vitamin C during cooking of vegetables is mainly due to oxidation and this is accelerated by exposure to air. High acidity prevents loss to a certain extent. Discarding the cooking water accounts for a considerable amount of loss of vitamin C. Contamination with copper also accelerates the destruction of vitamin C. The quantity of vitamin C lost from vegetables during cooking may vary from 10 to 60 per cent of the quantity present in the food, depending on the vegetable cooked and the method of cooking.

MINERALS:

Calcium and phosphorus: Cooking does not affect the calcium and phosphorus contents except when the cooking water is discarded. When vegetables are cooked in 'hard' water, appreciable amount of calcium present in the water may become incorporated in them.

Iron: There is practically no loss of iron during cooking of foods except when the cooked water is discarded. In general, cooking tends to increase the ease with which the body can absorb iron from foods. Further, dietary iron may be increased due to amounts picked up from iron knives used for slicing vegetables and from cast iron pans commonly used for roasting them.

XV. PROCESSED SUPPLEMENTARY FOODS —VEGETABLE MILK, MALT FOOD AND INDIAN MULTIPURPOSE FOOD

There is an acute shortage of milk and other protein-rich foods of animal origin in India. Consequently, the incidence of protein malnutrition is very high among preschool children and expectant and nursing mothers. Low cost processed supplementary foods based on oil-seeds and nuts and their meals have been developed at the Central Food Technological Research Institute, Mysore. The methods of preparation and nutritive value of some of the products, (1) vegetable milks and curds, (2) Nutritionally balanced malt foods, (3) Indian multi-purpose food, (4) Bal-Ahar, (5) Bal-Amul and (6) Lac-Tone are described in this chapter.

VEGETABLE MILK AND CURDS

The minimum daily requirements of milk for a balanced diet have been estimated at 10 ounces for adults and 15-25 ounces for children and infants. As against this, the *per capita* availability of milk and milk products in India is highly inadequate, being of the order of 5 ounces only. In countries like China, Japan and Indonesia, milk prepared from soya bean has been used as a substitute for cow's milk for feeding infants and children for the past several centuries. A thorough study of the method of preparation and the nutritive value of milk and curd from soya bean and groundnut has been carried out at the Central Food Technological Research Institute, Mysore. The processes for their preparation are briefly described below:

Preparation of soya bean milk and curds

Removal of husk: Soya bean is soaked in water for 2-4 hours and dried in the sun. The husk is removed by means of a wooden huller. The dhal thus obtained can be preserved for long periods. The dhal (one pound) is soaked in water overnight. Alternatively soya bean (one and half pounds) is soaked in water overnight. The husk is removed by rubbing and washing in water.

Removal of bitter principle: The soaked soya bean dhal is added to warm water (6 cups) containing half a teaspoon of sodium bicarbonate (cooking soda) and allowed to soak for about 10 minutes to remove the bitter principle and colouring matter present. The water is drained off.

Preparation of milk: The washed soya bean dhal is made into a fine paste in a stone grinder with the addition of a small amount of water. The paste is stirred in water (15 cups). The mixture is boiled for 15 minutes, allowed to cool slightly, and then strained through cloth. About half a cup of clear lime water (calcium hydroxide solution) is added. Sugar and common salt ($\frac{1}{2}$ teaspoon) are added to improve the taste. The residue can be used for food preparations like *dosai*, *vadai*, etc. The chemical composition of the milk is given in Table 26.

Preparation of curds: Two teaspoons of glucose powder, invert sugar or honey are added to 4 cups of milk. The milk is allowed to cool, seeded with a small quantity of cow's milk curds and allowed to remain for 12 hours to set. Soya bean curd is thus obtained.

Preparation of groundnut milk and curds

Roasting of groundnuts and removal of red skin: Good quality groundnut is given light roasting in a

pan. The shell is removed. Alternatively, if good quality groundnut kernel is available, it may be roasted lightly. The red skin is removed by rubbing and the spoilt kernels are picked out.

Preparation of milk: The decuticled groundnut kernel (one pound) is soaked in water for about 3 hours. The water is drained off. The soaked kernel is made into a fine paste in a stone grinder. The paste is mixed with 15 cups of cold water. Half a cup of clear lime water (calcium hydroxide solution) is added. One-quarter teaspoon of sodium bicarbonate dissolved in a little water is next added to stabilise the milk. *Excess of lime water and sodium bicarbonate should not be added.* The groundnut milk is strained through mull cloth and boiled for 5 minutes. Sugar may be added to taste if the groundnut milk is to be consumed as such.

Preparation of groundnut curds: Two teaspoons of glucose powder, invert sugar or honey are added to 4 cups of milk. The milk is allowed to cool, seeded with a small quantity of cow's milk curds and allowed to remain overnight to set. The curds can be used in the same way as cow's milk curds along with rice and for such preparations as *dhahivada*, butter milk etc.

Nutritive value of vegetable milk and curds: The chemical composition of soya bean and groundnut milks as compared with cow's milk is given in Table 26. The curd has almost the same composition as the milk. *Feeding trials on infants have shown that soya bean milk can be used as a substitute for milk for infants over 6 months of age: groundnut and soya bean curds have been found to possess a marked supplementary value to the diets of children.*

Table 26. **Chemical composition of soya bean and groundnut milks as compared with cow's milk**
(Values per 100g.)

Nutrients	Soya bean milk	Ground-nut milk	Cow's milk
Protein (g)	2.4	3.0	3.2
Fat (g)	2.5	5.2	4.9
Carbohydrate (g)	3.2	3.1	4.6
Calcium (g)	0.08	0.11	0.11
Phosphorus (g)	0.104	0.102	0.07
Iron (mg)	1.2	1.47	0.2
Calorific value	51	71	75
Thiamine (mg)	0.042	0.085	0.045
Riboflavin (mg)	0.04	0.03	0.17
Nicotinic acid (mg)	0.24	1.11	0.1

Note: One teaspoonful of shark liver oil or vitamins A and D concentrates should also be used daily along with soya bean and groundnut milks, to supply vitamins A and D.

NUTRITIONALLY BALANCED MALT FOOD

In our country where the *per capita* production of milk is low, the problem of supplying nutritious foods to weaned infants and young children has become very difficult. The children of the poorer classes after weaning are generally fed on cooked cereals or cereal gruels, both of which have a low protein content and are deficient in many essential vitamins and minerals. The incidence of protein malnutrition and vitamin deficiency diseases is consequently quite high among the children of the poorer classes. With a view to meeting the shortage in the supply of milk, the Central Food Technological Research Institute has developed processes for the preparation of vegetable milk substitutes from groundnut and soya bean. *Another product which is also highly nutritious and which can be prepared in the home is the nutritionally balanced malt food.* The method of preparation of the malt food is as follows:

Preparation of malt from ragi or cholam

Good quality seed grains (with percentage germination not less than 95) should be taken for preparing malt. The process involves the following steps:

(1) *Cleaning and steeping of the grain:* The grain is first cleaned free of mud, stones, etc., by winnowing and then washed well in water. It is then steeped in water in a tall vessel, so that the grain is not more than one third the height of the vessel. The water is changed in the morning and evening.

(2) *Couching:* After the grain is steeped for 24 hours, it is taken out of the steeping vessel and spread on a clean gunny matting in a cool dark place. The depth of the grain should not be more than 2″. A second wet gunny matting or cloth is used for covering the wet grain. At the end of every 24 hours, the cover is removed and the grain is piled up in the centre of the bottom gunny matting

and wetted with a little water. The grain is well mixed and spread again as before. The couching period is usually 72 hours.

(3) *Drying:* The grain is then taken out and spread in trays or on a clean cement floor and allowed to dry in the sun. When the grain is completely dry it is placed on a dry gunny sack and gently rubbed to separate the vegetative portion from the grain. The vegetative portion is removed by winnowing.

(4) *Roasting, powdering and sieving:* The grain is next roasted lightly in an iron pan to develop the characteristic malt flavour. Overroasting should be strictly avoided as this will adversely affect the malt flavour. The roasted grain is powdered to a fine flour and passed through a 70-80 mesh sieve.

The malt flour thus obtained can be preserved in air tight tins for a period of about one month.

Nutritive value: During malting, a part of the starch present in the grain is converted into dextrins and maltose. Hence malt is more readily digested by infants than cereal flours. There is also a slight increase in the content of B vitamins. There is practically no change in the contents of proteins and minerals.

Preparation of roasted Bengal gram flour

Bengal gram dhal is cleaned free of grit and foreign matter and roasted in a pan till a pleasant aroma develops. The roasted Bengal gram dhal is powdered in a flour mill. Puffed Bengal gram dhal obtained from the market can be used in place of roasted Bengal gram dhal.

Preparation of nutritionally balanced malt food

One pound of ragi malt flour is mixed with one pound of roasted or puffed Bengal gram dhal flour and half a pound of skimmed milk powder. The malt food can be kept in closed tins for a period of one to two

months. The chemical composition of the malt food as compared with that of ragi malt is given in Table 27.

Table 27. **The Chemical composition of malt and malt food**

Nutrients	Values per 100 g.	
	Ragi Malt	Nutritionally balanced malt food*
Protein (g)	6.2	19.0
Fat (g)	1.2	1.1
Carbohydrate (g)	79.5	68.5
Calcium (g)	0.32	0.45
Phosphorus (g)	0.28	0.36
Iron (mg)	2.5	2.4
Vitamin B_1 (mg)	0.36	0.38
Riboflavin (mg)	0.11	0.54
Nicotinic acid (mg)	1.8	1.7

* A daily supplement of half a teaspoon of shark liver oil should be given to supply vitamins A and D.

Cost

The cost of the malt food will be only about Rs 2.00 to 2.5 per kg.

Nutritive value

The malt food is rich in protein, calcium and riboflavin. It can be made into a porridge or pudding by cooking in the required amount of water and adding sugar to taste. Consumption of 2 ounces of malt food daily will provide liberal amounts of protein, calcium and riboflavin and *will thus form a good supplement to the diets of weaned infants and young children.*

INDIAN MULTIPURPOSE FOOD

It is a well recognised fact that malnutrition is widely prevalent among the poorer sections of the population in different parts of the country. Protective foods like milk, eggs, meat and fish are costly and are not available in adequate quantities. In view of this, investigations were undertaken at the Central Food Technological Research Institute, Mysore, for developing a food supplement rich in proteins, vitamins and minerals and known as Indian Multipurpose Food (M.P.F.). It is prepared from specially processed groundnut flour and Bengal gram flour and is fortified with essential minerals and vitamins. Its nutritive value is similar to that of the multipurpose food distributed by the Meals For Millions Foundation of U.S.A. The food can be easily incorporated in our diets, thus enhancing their nutritive value. It does not require any change in our food habits. It can be used as a low cost supplement to the diets of the vulnerable sections of the population, One ounce of this food will cost about *six paise* and will supply a fair portion of the daily requirements of proteins minerals and vitamins for adults and children.

Different forms

It is available in 3 forms:

(A) *Seasoned:* With salt and spices for use in the preparation of savoury dishes and dhal substitute.

(B) *Unseasoned:* For use in sweet dishes such as toffees, porridge and pudding.

(C) *Unseasoned with 20 per cent skimmed milk powder:* For use in porridge and pudding, for feeding weaned infants and convalescents and for the treatment of protein malnutrition.

Nutritive value

The following Table 28 gives the nutritive value of Indian MPF as compared with the American

MPF, Bengal gram dhal and skimmed milk powder. It will be noted that the *Indian multipurpose food contains about twice as much protein and 2 to 4 times as much calcium, thiamine and riboflavin as Bengal gram dhal and other pulses. Further, it is a good source of vitamins A and D in which pulses and skimmed milk powder are deficient.*

Table 28. **The chemical composition of Indian MPF as compared with that of American MPF, Bengal gram dhal and skimmed milk powder** (Values per 100 g.)

Nutrients	Indian MPF	Bengal gram dhal	American MPF	Skimmed milk powder
Protein (g)	42.9	22.3	42.3	35.6
Fat (g)	8.5	5.2	7.6	1.0
Carbohydrate (g)	35.8	58.9	36.9	52.0
Calcium (g)	0.665	0.07	0.587	1.3
Phosphorus (g)	0.820	0.31	0.440	1.03
Iron (mg)	5.1	8.9	7.0	0.6
Thiamine (mg)	1.3	0.32	0.7	0.35
Nicotinic acid (mg)	14.3	2.6	7.0	1.1
Riboflavin (mg)	3.0	0.21	1.2	1.95
Vitamin A (I.U.)	3000	nil	2940	40
,, D (I.U.)	300	nil	235	nil
Calorific value	387	372	386	359

Consumer acceptability trials have shown that both the *seasoned* and *unseasoned* varieties can be incorporated in preparations based on cereals and pulses up to 25-50 per cent levels in the average diets.

Feeding experiments on children have shown that supplementation of the usual diet with 2 ounces of MPF for a period of five months produces a significant increase in the growth and nutritional status of the children. Indian MPF containing skimmed milk powder (formula C) has been successfully employed in treating several cases of protein malnutrition in children.

Several recipes containing Indian MPF have been standardised. Recipe booklets are available on request from the Discipline of Industrial Research, Consultancy and Extension, Central Food Technological Research Institute, Mysore.

Other supplementary foods

Bal-Ahar: A process for the preparation of a weaning food known as Bal-Ahar based on a blend of cereal flours, groundnut flour and Bengal gram flour and fortified with vitamins and calcium salts has been developed at the Central Food Technological Research Institute, Mysore.

Bal-Amul: A process for the preparation of a pre-cooked weaning food—Bal-Amul—based on wheat flour and soya bean and fortified with vitamins and minerals has been developed by C.F.T.R.I., Mysore, in collaboration with the Kaira Co-operative Milk Producers' Union, Anand.

Lac-Tone: A process for the preparation of *toned vegetable milk* (*Lac-Tone*) based on a blend of groundnut protein isolate, liquid glucose and buffalo milk has been developed at C.F.T.R.I., Mysore. Large scale production of Lac-Tone will help to extend the available supplies of milk in the country.

The composition of these foods is shown in Tables 29 and 30.

Table 29. **The nutritive value of Bal-Ahar and Bal-Amul**
(Values per 100 g.)

Nutrients	Bal-Ahar	Bal-Amul
Protein (g)	25.0	25.4
Fat (g)	4.0	4.5
Carbohydrates (g)	56.0	55.0
Calcium (g)	0.60	1.0
Iron (mg)	6.0	5.0
Vitamin A (I.U.)	3000	3000
Vitamin D (I.U.)	200	400
Thiamine (mg)	0.7	0.5
Riboflavin (mg)	1.0	0.6
Nicotinic acid (mg)	8.0	5.0

Table 30. **The nutritive value of toned vegetable milk (Lac-Tone) as compared with cow's milk**

Constituents	Toned-vegetable milk (Lac-Tone)	Cow's milk
Moisture (g)	88.0	87.4
Protein (g)	3.5	3.5
Fat (g)	3.0	3.5
Ash (g)	0.7	0.7
Carbohydrates (g) by diff.	4.8	4.9
Calcium (mg)	120	118
Phosphorus (mg)	110	93
Iron (mg)	1.0	0.07
Vitamin A (I.U.)	150	140
Thiamine (mg)	0.10	0.03
Riboflavin (mg)	0.20	0.17
Niacin (mg)	1.0	0.1
Ascorbic acid (mg)	3.0	1.0

XVI. FOOD PRODUCTION IN INDIA AND FOOD REQUIREMENTS

It is now well recognised that the production of different categories of foods in India is inadequate to meet the needs of the population. The population has been increasing at the rate of about 2.0 per cent, i.e., about 10 million per year. The food production has also been increasing nearly at the same rate, with the result, the *per capita* food production has been almost stationary excepting in the case of cereals. The problem is discussed under the following heads: (1) Present food production and consumption, (2) Increase in population, (3) Land available *per capita* and food production, (4) 'Practical Nutritional Target' and future food requirements, and (5) Future food production to meet the needs of the population.

(1) Present food production and consumption

Data regarding the *per capita* daily consumption and production of foodstuffs in India are given in Tables 31 and 32. The country has been importing cereals to the tune of 5-10 million tons every year, which involves heavy expenditure. Further the consumption of all categories of foodstuffs is inadequate to meet the needs of the population. The diets are deficient both in quantity and quality.

(2) Increase in population

The rates of increases in population estimated by Sukhatme and the Planning Commission are shown in Table 33.

(3) Land available *per capita* and food production

The *per capita* land available and *per capita* production of certain essential foodstuffs in India as compared with

Table 31. **Food consumption pattern in the different States (grams per adult consumption unit)**

State	Rice	Wheat	Millets	Other Cereals	Total Cereals	Pulses	Milk and Milk Products	Meat, fish and eggs	Leafy Vegetables	Other Vegetables	Fruits	Oils	Sugar and Jaggery
Andhra Pradesh	280	20	182	22	504	39	86	14	18	43	1	16	10
Bihar	379	36	60	28	504	77	16	10	36	92	12	11	4
Gujarat	73	60	181	108	422	71	138	4	4	51	10	16	22
Himachal Pradesh	270	151	—	337	758	57	27	3	24	23	—	4	7
Kerala	392	—	—	—	392	15	12	30	>1	122	19	7	5
Madhya Pradesh	495	200	17	—	712	85	77	13	16	96	4	14	21
Madras	382	12	104	9	507	42	58	19	15	81	12	16	15
Maharashtra	208	86	133	17	445	55	113	14	17	88	18	31	38
Mysore	405	17	67	1	490	20	40	26	8	51	27	5	12
Punjab	102	301	88	107	598	62	228	5	39	87	14	26	88
Uttar Pradesh	294	113	176	23	606	91	48	11	54	96	13	18	30
West Bengal	502	46	—	—	548	76	77	58	81	133	8	19	39
All India					470	70	80	15	29	90	5	15	20
Recommended for a typical balanced diet.					400	85	284	125	114	170	85	57	57

Source of data : (1) Report of Nutrition work done in States—1950 to 1960.
(2) Nutrition in India (1960)—G. G. Pandit and K. Someswara Rao.

Table 32. **Production of cereals, pulses, roots and tubers and milk in different States of India* (1960–61)**

State	Population (in thousands)	Total production per annum (in thousand tonnes)				g/per caput/day			
		Cereals	Pulses	Roots and tubers	Milk	Cereals	Pulses	Roots and tubers	Milk
Andhra Pradesh	36215	6070	276	32.9	1757	453	21.0	2.5	131
Assam	11988	1763	26	177.5	156	397	6.0	39.9	35
Bihar	46811	6230	1200	676.0	1803	359	69.0	39.0	104
Gujarat	20820	1718	170	51.7	1565	223	22.1	6.7	203
Jammu-Kashmir	3577	625	21	—	110	469	15.8	—	83
Kerala	17044	1080	17	1602.9	219	172	2.7	254.5	35
Madhya Pradesh	32640	8061	1821	155.7	1052	668	150.7	12.9	87
Madras	33877	5182	112	352.7	1014	413	8.9	28.1	81
Maharashtra	39892	6757	989	218.5	1322	457	67.0	14.8	90
Mysore	23769	3578	352	77.4	577	406	39.9	8.8	65
Orissa	17678	3794	219	47.0	350	579	33.4	7.3	53
Punjab	20514	4203	2054	184.0	2271	574	280.5	25.1	310
Rajasthan	20849	3339	1202	3.0	2384	431	185.3	0.4	308
Uttar Pradesh	74293	10675	3826	1141.0	4111	388	139.0	41.5	149
West Bengal	35241	5545	391	595.5	564	425	30.0	45.7	43
All India	440000	69314	12804	5355.0	22353	425	78.6	32.9	140

* Ref: *Diet Atlas*, Spl. Rep. No. 48, I.C.M.R., New Delhi.

Table 33. **Projected growth of India's population***

	1960	1961	1971	1976	1981
Projection I					
Population (millions)	430	438	535	585	630
Index	100	102	124	136	147
Rate of increase		2%	2%	1.8%	1.5%
Projection II					
Population (millions)	430	438	555	625	690
Index	100	102	129	145	160
Rate of increase		2%	2.5%	2.5%	2%

* P. V. SUKHATME (1965) *Feeding India's Growing Millions*, Asia Publishing House, London.

other countries are given in Table 34. The data show that the *per capita* land available in India is very low as compared with U.S.A., Canada and Australia. Consequently, the production of animal foods such as milk, meat and eggs is also very low as compared with U.S.A., Canada and Australia, as the *per capita* land required for the production of animal foods is greater than that required for the production of foods of vegetable origin when compared on equicalorie basis (Table 35).

Availability of foods for consumption as compared with an ideal balanced diet and practical nutritional target

Data regarding the estimated production of different categories of foods *per capita* per day (1963-64) compared with requirements for an ideal balanced diet suggested by the Nutrition Advisory Committee, I.C.M.R., and a practical nutritional target are given in Table 36. The position regarding different groups of foodstuffs is briefly discussed below:

Cereals

The estimated *per capita* availability of cereals for consumption in 1963-65 was 404 g./day. This included the

Table 34. **Population, Agricultural area and production of cereals, milk, fish and meat in some countries* (1964)**

Country	Population (in 1000)	Total Agricultural Land (in 1000 hectares[1])		Total production/year (in 1000 metric tons)				Agricultural land per caput (acres)		Food Production/ caput/day (grams)			
		Arable lands and lands under crops	Pastures and Meadows	Cereals	Milk	Fish	Meat	Arable lands and lands under crops	Pastures and Meadows	Cereals	Milk	Fish	Meat
India	4,71,524	1,61,940	14,220	93,160	22,614	1,320	1,053	0.85	0.07	541	131	8	2
Japan	96,906	6,004	948	19,067	3,027	6,351	1,016	0.15	0.03	539	85	180	29
U.S.A.	1,92,119	1,85,152	2,56,214	1,60,944	57,606	4,300	29,681	2.38	3.30	2,295	822	61	423
Australia	11,136	36,352	4,46,318	12,944	7,013	77	3,481	8.1	99.0	3,197	1,726	19	856
Canada	19,237	41,485	21,003	32,035	8,402	1,211	2,547	5.3	2.7	4,563	1,197	172	363

* F.A.O. Production Year Book (1966), Vol. 20.

[1] One hectare=2.47 acres

Table 35. **Land (Acres) required to produce 84,000 calories of same foods**

Name of food	Crop land (acres)	Pasture (acres)	Total (acres)
Potatoes	0.45	—	0.45
Corn (maize)	0.47	—	0.47
Wheat	0.87	—	0.87
Milk	1.44	1.0	2.44
Beef	6.6	1.5	8.1

84,000 calories represents the calorie requirements of an adult per annum (at the rate of 2400 calories per day.)

imported cereals. In view of the inadequate calorie intake due to shortage of oils and fats, meat, fish and milk, it is necessary to make up the calorie deficit by increasing the production and consumption of cereals. Further, cereals are cheaper sources of calories as compared to oils and fats, being at the same time fair sources of proteins, minerals and B-vitamins.

Pulses

The estimated availability of pulses *per capita*/day is about 61 g. as against the requirements of 70 g. for a balanced diet. In view of the shortage in the supply of meat, fish, eggs and milk, it is desirable to increase the availability to 95 g. *per capita* per day. Further, pulses are cheaper sources of protein than foods of animal origin.

Milk

The average availability of milk *per capita*/day is only 123 g. as compared with the requirements of 240 g. for an ideal balanced diet. It is difficult to increase the *per capita* production of milk to an appreciable extent. The milk shortage can be made up by the production

Table 36. **Availability of food for consumption as compared with an ideal balanced diet and practical nutritional target (g/*per capita*/day)**

	Ideal balanced diet[1]	Practical nutritional target[3]	Availability of food for consumption[2], (1963-65)
Cereals	400	450	404
Pulses	85	95	61
Vegetables, green leafy	114	80	—
„ roots and tubers	85	30	37
„ others	85	40	—
Fruits	85	45	45
Milk	284	140	123
Sugar and jaggery	57	45	50
Oils and fats	57	15	11
Fish and meat	85	14	7
Eggs	40	2	1

[1] Nutrition Advisory Committee, I.C.M.R.
[2] F.A.O. Production Year Book, Vol. 20.
[3] Swaminathan, M. (1968), Journal of Nutrition and Dietetics, Vol. 5, p. 225.

of milk substitutes based on oilseeds and nuts as discussed in Chapter XV.

Meat, fish and eggs

The estimated *per capita* availability of meat, fish and eggs is only 12 g./day as compared with 125g. required for a balanced diet. Since there are little prospects of increasing their production in the near future due to non-availability of land for the production of fodder, alternate and cheaper sources of proteins such as pulses, nuts and oilseeds and their meals should be used as supplements to the diets.

Nuts and oilseeds

Edible nuts and oilseeds are, at present, used mainly as sources of oils and fats. Their production could be

increased, as they can be consumed as such to some extent in the diet. Edible oilseed meals can be used for the production of processed protein foods suitable for supplementing the diets of children (Chapter XV).

Oils and fats

The main *per capita* daily availability of oils and fats is only 11 g. as against the requirements of 57 g. for a balanced diet. It will be desirable to increase the availability of fats to at least 15 g. *per capita*/day, as oils and fats provide the essential fatty acids required for optimal nutrition.

Sugar and jaggery

The present production of sugar and jaggery (50 g. *per capita*/day) is adequate to meet the needs of the people.

Vegetables

The present production of vegetables is inadequate to meet the needs of the population. The production of *green leafy vegetables* should be encouraged as a kitchen garden crop, as they are rich sources of carotene (provitamin A), minerals and vitamin C.

Fruits

The present production of fruits is inadequate to meet the needs of the population. The production of cheap nutritious fruits such as papaya, tomato, guava and amla should be encouraged as a kitchen garden crop.

(4) Practical nutritional target and future food requirements

In view of the low *per capita* land available in India, and the steady increase in the population and low yield of crops and low yield of milk by milch cattles, it is essential to *formulate practical nutritional target on the basis of the present food production potentials of the country*. A 'Practical Nutritional Target' which will just meet the

minimum nutritional needs of the low income groups of the people and help to prevent undernutrition and malnutrition is given in Table 37. *The aim should be to give high priority to increasing the production of cereals and pulses which are the staple foods of the low income groups.*

(5) Future food production required to meet the needs of the population

In making estimates of production of foodstuffs required to meet the practical nutritional targets mentioned in Table 37, it is essential to make provision for (1) losses of all categories of foodstuffs during storage and handling (about 10 per cent in the case of cereals, pulses, oilseeds, fruits and vegetables), (2) requirements for seed (estimated at about 10 per cent in the case of cereals, pulses and oilseeds and nuts) and (3) variations in food production due to the vagaries of the monsoon, etc. (about 10 per cent). *The actual target of food production should, therefore, be at least 20 per cent excess of the foods required for consumption.* The future food needs of the population are indicated in Table 37.

Conclusion

It is evident from the above account that the present production of cereals and pulses is highly inadequate to meet the needs of the population. *Immediate steps should be taken to increase the production of cereals and pulses by 50 per cent and to maintain the production of these foods in proportion to the increase in population.* At the same time the production of other foods, viz., milk, meat, fish, and eggs, vegetables, fruits, oilseeds and nuts and sugar and jaggery should be gradually increased to meet the needs of the increasing population. The shortage in the production of protein-rich and protective foods can be made up by the production of processed protein foods and infant foods based on oilseeds and nuts (See Chapter XV).

India according to practical nutritional target[1]

Item	Practical Nutritional Target[1] (grams/day/caput)		Total food supplies (million tons per annum)					
			1971		1976		1981	
	Production target*	Availability for consumption	Production target	Availability for consumption	Production target	Availability for consumption	Production target	Availability for consumption
Foodstuffs:								
Cereals	540	450	105.1	87.6	115.3	96.1	124.7	103.9
Roots and Tubers	36	30	7.0	5.8	7.7	6.4	8.3	6.9
Sugar	54	45	10.6	8.8	11.5	9.6	12.5	10.4
Pulses	114	95	22.2	18.5	24.4	20.3	26.3	21.9
Fruits and Vegetables	153	137	32.0	26.7	35.2	29.3	37.9	31.6
Meat	5	4	0.94	0.78	1.1	0.86	1.1	0.93
Fish	12	10	2.4	1.98	2.6	2.18	2.8	2.35
Eggs	3	2	0.6	0.40	0.66	0.44	0.7	0.49
Milk	154	140	29.9	27.2	33.9	29.90	35.5	22.3
Fats and Oils	18	15	3.54	2.95	3.9	3.25	4.3	3.54
Edible nuts and oilseeds	45	37	8.7	7.2	10.4	8.64	11.4	9.51

* Includes 20% excess to allow for losses in storage and handling and used for seed purposes and variations in yields due to seasonal and other unforeseen factors and 10% excess in the case of milk.

[1] Swaminathan, M. (1968), J. Nutrition and Dietetics, Vol. 5, p. 225, published by Shri Avinashilingam Home Science College, Coimbatore.

XVII. APPLIED NUTRITION PROGRAMME IN INDIA

The Applied Nutrition Programme aims at remedying the widely prevalent malnutrition and undernutrition in the country. The programme is basically to educate the people in the rural areas in the increased production, preservation and consumption of energy yielding and protective foods. The Government of India introduced in 1963 the Applied Nutrition Programme in 222 Community Development Blocks distributed all over the country with the help of UNICEF, FAO and WHO.

Objectives

The main objectives of the Applied Nutrition Programme are as follows:

1. To develop progressively a co-ordinated and comprehensive national programme of education and training in applied nutrition and related subjects with the object of establishing an effective field service to improve local diets through production, preservation and use of protective foods.

2. To ensure effective utilisation of these protective foods by pregnant and nursing women and preschool and school children.

3. To provide progressively facilities for the training and orientation of tutorial staff required for the educational institutions and training centres participating in this programme as well as for training of managerial and supervisory personnel to be engaged in the various fields of this programme; To upgrade and extend facilities for training in nutrition for selective groups of personnel engaged in the national community development programme.

4. To assist in the extension of applied nutrition programme in community development blocks in the

vicinity of training institutions for demonstration and training purposes: and

5. To promote through demonstration and education, among village communities sound and hygienic practices for production, preservation and use of protective foods.

Training of personnel

As a first phase, facilities for the presentation of practical courses in poultry management, dairying, fisheries (inland and marine), horticulture and home science, and in the teaching of applied human nutrition are being strengthened in selected training institutions, such as Rural Extension Training Centres. With such facilities these Institutions may be able to undertake immediately a programme of training of villagers, youth or women leaders, extension personnel and other official and non-official workers. Adjacent Community Development blocks have been associated with these training centres so that the Blocks may serve as practical field laboratories for the trainees and the teaching staff of these Institutions.

As a second phase, permanent training facilities in applied human nutrition will be established in the Agricultural Colleges, Colleges of Veterinary Science, Home Science Colleges, appropriate health Institutions and other training institutions in order to build the desired nutrition bias into the curriculae of these institutions which turn out personnel who have much to do with rural communities.

The training aspects of this programme must be developed in such a manner that it will eventually make an impact at all levels in the community, namely, at the national, state, district, block and village levels and among all planning, administrative and technical officers associated with the programme, teachers in colleges of agriculture, veterinary science, human nutrition and home science, appropriate public health institutions concerned with the training of public health workers, teachers in Gram sevak/Gram Sevikas' Training Centres, Social Education

Organizers' Training Centres, Block level officers, village level workers, members of Panchayat Raj Institutions, non-official and voluntary organisations and above all, the farmers and villagers themselves.

Production of protective foods

The production of protective foods is being achieved at the village level by (*a*) establishing school gardens and orchards; (*b*) setting up poultry units; (*c*) production of fish in local tanks and (*d*) inshore fishery in selected centres in coastal areas. In addition, some States have programmes for better and increased milk yield by the production of better fodder and legumes and by improving the breed of cattle.

Demonstration Feeding

One of the objectives of this programme is to carry out demonstrations of feeding the vulnerable groups of people, i.e., pregnant and nursing mothers and pre-school and school children with protective foods. Therefore, it has been laid down that as a result of the assistance which will be rendered to different components of the programme, a percentage of the food thus produced would be given free for this purpose.

Role of International agencies

The International Agencies responsible for this Programme are UNICEF, FAO and WHO. The UNICEF assists the training institutions and blocks participating in the programme in the state and regional production centres in poultry farming, fishery, horticulture, dairying, etc. The UNICEF assistance is also available for supply of vehicles, equipment for poultry, pisciculture and tools for horticulture, irrigation, equipment including pipes, seeds, etc.

The UNICEF assistance to training institutions depends on the type and individual needs of these institutions. The UNICEF also provides assistance for the

production of text-books, literature and visual education aids. It gives stipends for trainees and honoraria, etc. The total assistance of the UNICEF for 222 blocks during the Third Plan period has been estimated to the extent of 10 million dollars (75 million rupees).

The FAO provides technical assistance for all the components of the programme. The WHO through its regional offices, provides technical assistance in the field of health and will also provide, subject to availability of funds, a paediatrician experienced in different health practices and in the application of principles of nutrition for feeding the vulnerable groups.

Role of other agencies

Primary Health Centre: The Medical Officer in-charge of the Primary Health Centre will be responsible for the feeding of the beneficiaries. He will make sure that the instructions issued by the State Nutrition Officer are being carried out. The Medical Officer and his staff will help impart nutrition education to the people who come to the centre and subcentre for medical care. Particular emphasis will be laid on the expectant and nursing mothers, preschool and school children.

Women's Organisations: In each block, a number of Mahila Samitis/Mandals and Youth Clubs have to be established under the existing programme. These women's organisations have an important role to play as they are being entrusted with the feeding of preschool and school children. These organisations are being supplied utensils, etc., for cooking and serving balanced menus. Training programme and cooking demonstrations have been organised for the members of women's organisations, so that they are able to discharge their duties satisfactorily under the overall supervision of Mukhya Sevika/Gram Sevika. Our main effort is to develop this programme through women because they are responsible for preparation of food in the family. Therefore, any change in the food habits must primarily be accepted by women.

Mahila Samitis/Mandals are being encouraged to undertake poultry farming. If the panchayats agree the fishery tanks may also be handed over to these organisations, so that they become self-sufficient financially. A part of the produce (eggs and fish) can be utilised for feeding the vulnerable group (if they have no objection to non-vegetarian meals).

Balwadis: Under this programme, a certain number of Balwadis have to be organised in each block where the preschool children can gather for recreation and meal. Very often Balwadis are housed in the same building as the Mahila Samitis.

Youth Clubs: These clubs are encouraged to take plots of land for cultivation of vegetables, so that the youth learn new practices in farming. This system also establishes a spirit of competition between the boys. The individual member may take the vegetables produced from the plot he has cultivated. Youth clubs are also encouraged to take up poultry units.

School teachers: The success of the programme for school gardens will depend upon the interest and leadership of the teacher. Therefore, the subject of nutrition has been included in the syllabus of teacher training courses.

Action programme at the State level

As soon as the Subsidiary Plan of operation is signed for a State Government, a co-ordination committee is established at the state, district and block levels. A number of villages where the applied nutrition programme is to be implemented in the blocks are selected jointly by the representatives of the Block Samiti in consultation with the Block Development Officer, Principal of the Training Centre and Medical Officer in-charge of the Primary Health Centre. Certain criteria have been laid down for selection of villages, schools, ponds, etc., so that certain components of the programme mentioned above can be developed. Another important

point is that the willingness, co-operation and participation of the village people should also be forthcoming. Mahila Samitis/Mandals and Youth Clubs have to be organized simultaneously.

The State Nutrition Officer, in consultation with the Officer-in-charge of the applied nutrition programme in the State, formulates a training programme for different categories of persons (official and non-official) employed in the implementation of this programme. He carries out a quick base line survey of the diet and nutrition status in these villages. The officer-in-charge of the programme at the State level prepares an indent for the required equipment, seeds, fertilizers and vehicles. The indent is sent to the Ministry of Community Development and Co-operation for approval and for forwarding to the UNICEF.

The District Level Officers have the responsibility of giving guidance and supervising the programme. The District Officers responsible for horticulture, animal husbandry, fishery, etc., have to organise for the supply of seeds, birds, fisherlings, etc., to the villages and units where the programme is to be implemented. State/Regional farms have to be established for this purpose.

The State Governments arrange concurrent evaluation with the help of the State Evaluation Organisation and every two to three years carry out a proper evaluation of the programme.

XVIII. ROLE OF SCIENCE AND TECHNOLOGY IN AUGMENTING OUR FOOD SUPPLIES

By the application of the newer techniques of science and technology, it is possible to increase the food supplies to meet the needs of the population. These are discussed under the following heads: (1) Increased production of food, (2) Improved methods of storage of foodgrains and perishable foods to avoid waste, (3) Preservation of perishable foods by using modern technology, (4) Improved methods of milling of rice and wheat, (5) Augmenting the supplies of oils and fats by extraction of rice bran, and oilseed cakes and cottonseed using food grade solvents, and (6) Production of supplementary protein foods and infant foods based on nuts and oilseeds and their meals and fortified with minerals, vitamins and essential amino acids.

1. Increased production of food

During recent years, great advances have been made in U.S.A., Japan and in many other developed countries in obtaining large yields of foodgrains by the application of the modern techniques of agriculture. These include use of high yielding strains, fertilizer, irrigation and also control of field pests using insecticides. Data regarding the comparative yield of some foodstuffs in India, U.A.R., Japan, Italy and U.S.A. are given in Table 38. It is evident that the yields of different food commodities in other countries are 3-4 times those obtained in India. It is evident that if India also adopts similar modern techniques, it should be possible to increase 2-3 times the production of all foodstuffs in the course of 5-10 years. Recently marked increases in the production of cereals and millets have been achieved in India by the use of hybrid strains. Similarly, by adopting modern techniques of dairying, poultry keeping, piggery and sheep and goat development and fisheries, it will be

Table 38. **Yield of food-grains, legumes and oilseeds per hectare * in some countries (kg/hectare)**

Country	Wheat	Maize	Millets	Rice (Paddy)	Peas (Dried)	Groundnut	Chickpea
India	790	1000	470	1540	780	780	580
Japan	1230	2670	1330	5240	890	2360	—
Italy	1850	3290	4090	5120	830	2440	660
United Arab Republic	2590	2350	3450	5840	—	2020	1690
U.S.A.	1700	4240	2720	4440	1670	1610	—

* One hectare=2.47 acres

possible to effect substantial increases in the production of milk, eggs, meat and fish. These problems are discussed in the FAO publication 'Possibilities of Increasing World Food Production' FFHC Basic Study No. 10.

2. Adoption of Improved methods of storage of foodgrains and of perishable foods

At present, about 10 to 20 per cent of the food commodities are wasted during storage as a result of spoilage due to insects, fungus and bacteria. By adopting modern storage techniques, it is possible to prevent these losses as discussed below.

Prevention of losses of foodgrains, pulses and oilseeds and nuts during storage

Data given in Table 39 show that large quantities of foodgrains are lost due to insect infestation during storage in the tropical countries. Losses of similar magnitudes occur with respect to pulses, oilseeds and nuts. Studies carried out in C.F.T.R.I., Mysore, have shown that by the fumigation of the food commodities with mixtures of

Table 39. **Some estimates of losses of foodgrains in different Countries**

Country	Material	Loss% or value	Reference
Nigeria	Sorghum	46	Colon. Res. Publ. 1952
	Cowpea	41	No. 12, 40.
U.S.A.	Stored grain	500 million	Metcalf, R.L.
	Packed food	150 million	Destructive and
	All crops	3500 million	Useful insects, 1962 41-43.
India	All grains	25 field loss 15 storage loss 7 handling and processing 3 other losses	C.F.T.R.I. Res. & Ind. Conf. C.S.I.R., New Delhi, 1968.
Germany	Harvested grain	DM 71.4 million	Frey, W. Flugblatt Biol. Bundesanstalt 1951, Nr. 05, 8.
Sierra Leone	Rice	41	Colon. Res. Stud. 1959, No. 28, 52.
	Maize	14	Tech. Rep. W. Afr. Stored Prod. Res. Unit 1962, No. 13.
Tropical Africa	All crops (Storage and handling)	30	F.A.O. Informal Work Bull., 24, 1964

fumigants, viz., a mixture of methyl bromide and ethylene dibromide to destroy existing infestation and by storing them in jute bags impregnated on the outside with insecticides, it is possible to prevent the heavy losses of foodgrains, pulses, oilseeds and nuts due to insect infestation occurring at present. (Addition of tricalcium phosphate at 1-2 per cent levels to foodgrains and to flour has also been found to be effective in preventing insect infestation, besides helping to make up calcium deficiency in the diet.

Cold storage of fruits and vegetables

Optimal cold storage conditions for the preservation of fresh fruits and vegetables over long periods (4-8 months) have been worked out. Treatment of fruits and

vegetables with wax emulsions containing fungicides and growth regulators helps to extend the storage life two to four-fold both at room temperature and under cold storage conditions.

Cold storage of fish, meat and eggs

Cold storages of fish, meat and eggs are being carried out on a limited scale in a few localities. There is an urgent need for extending the freezing storage facilities for the storage of fish, meat and eggs.

3. Preservation of perishable foods by using modern food technology

The preservation of vegetables and fruits by canning is being carried on a limited scale. Some progress has been made by the dehydrated vegetable and fruit industry. Large quantities of squashes, fruit juices, jams and jellies are being manufactured in the country. Canned meat and fish are being manufactured to a limited extent. Large quantities of dehydrated fish, prepared by drying in the sun, are being manufactured in the country. Data regarding the production and import and export of some food products are given in Tables 40-42.

Processing of milk

Large quantities of infant milk food (Amul Infant Food) based on the formula developed by C.F.T.R.I., Mysore, are being manufactured by the Kaira Co-operative Milk Producers' Union, Anand. The other products manufactured by the dairy industry are butter, cheese, whole milk powder, skim milk powder and condensed milk.

4. Improved milling of rice and wheat

Rice: More than half the rice consumed in India is parboiled rice, the remainder being raw rice. Parboiling helps to retain more B-vitamins and gives a higher yield

Table 40. **Production of Fruit and Vegetable Products in India (1960)**

	Name of the product	Quantity (tonnes)	Value in rupees (in thousands)
1.	Synthetic syrups	1,024	2,142
2.	Fruit beverages	5,748	8,306
3.	Juices and Pulps	1,908	3,755
4.	Vinegar	1,140	1,029
5.	Chutney	1,039	2,078
6.	Preserves	2,078	3,629
7.	Crystallised fruits	206	435
8.	Jams, jellies and marmalades	1,545	3,717
9.	Tomato products and other sauces	953	2,076
10.	Pickles	7,489	5,554
11.	Canned Fruits	2,328	4,782
12.	Canned vegetables	3,737	6,091
13.	Aerated Fruit beverages	10,435	9,467
14.	Others	172	467

(about 10 per cent) of head rice. As a result of improvements made in C.F.T.R.I. in the process of parboiling, it is now possible to prepare parboiled rice acceptable to consumers of raw rice. Improvements have also been effected in the yield of raw rice to the extent of 5-10 per cent by the use of improved milling equipment. A simple curing procedure involving steaming for 5 minutes, of freshly harvested paddy has been developed for improving the cooking quality of rice obtained from freshly harvested paddy. The curing process helps to harden the rice and thereby reduce breakage during milling.

Wheat: The present production of wheat flour of 70 per cent extraction in India is of the order of 3 million tonnes. In England, during the last war, National Wheat Flour of 85 per cent extraction was manufactured instead of 70 per cent extraction flour with a view to economise on the import of wheat. Production of wheat flour of 85 per cent extraction will help to save about 3 lakh tons of wheat in India. Enrichment of flour with calcium, iron and vitamins can be carried out at low cost.

OUR FOOD

Table 41. **Installed capacity and production of some food industries**

	Accounting Unit	1959 No. of units	Installed capacity	Actual production
Food Industries				
1. Beer and Ale	Million gallons	3	—	—
2. Biscuits	tons	40	30,528	19,752
3. *Breakfast foods*				
(*i*) Corn and wheat flakes	,,	4	1,950	174
(*ii*) Processed and pearl barley	,,	4	4,920	1,289
(*iii*) Processed and rolled oats and oat flakes	,,	4	1,401	344
4. *Chocolate and Cocoa powder*				
(*i*) Chocolate (including drinking Chocolate)	,,	3	1,062	597
(*ii*) Cocoa butter	,,	3	438	5
(*iii*) Cocoa powder	,,			90
5. Confectionery	,,	43	51,744	13,327
6. Flour milling	,,	64	1,864,044	954,994
7. *Liquid glucose and dextrose*				
Liquid glucose	,,	3	11,400	6,430
Dextrose powder	,,	3	5,700	2,414
8. *Vegetable Oils*				
(*i*) Cottonseed oil	,,	9	130,560 seed	8,720 oil
(*ii*) Oil milling	,,	350	1,495,000 seed	304,000 oil
(*iii*) Solvent extracted oil from oil seed cakes	,,	17	302,500 Cake	20,700 Oil

5. Increasing the production of oils and fats by solvent extraction

The present production of oils and fats in India is highly inadequate to meet the needs of the people. There is scope for producing about 500,000 to 600,000

Table 42. **India's Foreign Trade (1960-61) in Food**

	Materials	Export (Rupees)	Import (Rupees)
1.	Live animals chiefly for food	12,19,394	2,62,170
2.	Meat and meat preparations	94,24,067	17,84,211
3.	Dairy products, eggs and honey	42,46,628	5,87,50,957
4.	Fish and fish preparations	4,61,86,646	3,54,03,567
5.	Cereals and cereal preparations	7,88,340	144,86,17,889
6.	Fruits and vegetables	26,08,48,824	20,38,67,091
7.	Sugar and sugar preparations (Confectionery)	3,34,76,213	7,43,238
8.	Coffee, tea, cocoa, spices and manufactures thereof	147,45,94,528	1,98,20,635
9.	Miscellaneous food preparations	9,12,698	24,27,178
10.	Beverages (non-alcoholic and alcoholic)	43,964	53,94,313
11.	Oilseeds, oil nuts and oil kernels	5,12,77,003	1,16,401,061
12.	Animal and vegetable oils, fats, greases and derivatives	9,77,17,986	4,59,81,767

tonnes of oil and fats by the solvent extraction of edible oilseed cakes, rice bran and cottonseed. Solvent extraction processes are being widely used in all advanced countries such as U.S.A., Japan, etc., for the production of edible oil.

6. Production of supplementary protein foods and infant foods based on oilseeds and oilseed meals

Since the production of milk and other protein foods of animal origin, viz., meat, eggs and fish is highly inadequate to meet the needs of the vulnerable groups of the population, studies have been carried out at C.F.T.R.I., Mysore, on the production of infant foods, milk substitutes and processed protein foods, weaning foods based on oilseeds and nuts and their meals for use as supplements to the diets. The methods of preparation and nutritive value of milk substitutes, balanced malt food and multipurpose food and some other products are given in Chapter XV.

XIX. REQUIREMENTS OF DIETARY ESSENTIALS

For maintaining proper health and physical efficiency, the diet should contain sufficient amounts of all nutrients. For designing balanced diets, we should know the daily requirements of the different dietary essentials. The figures given in Table 43, are the standards suggested by the Nutrition Advisory Committee, I.C.M.R., India. The standards suggested by British Medical Association, U.K., the Food and Nutrition Board of the National Research Council, U.S.A. and the Ministry of Health and Welfare of Japan are given in Tables 44, 45 and 46. These figures represent the *optimum* requirements for individuals of varying age, physical activity and physiological state.

(I) Energy

An Expert Commission of the League of Nations has drawn up the following statement about energy requirements:

(*a*) An adult, male or female, living an ordinary everyday life in a temperate climate and not engaged in manual work is taken as the basis on which the needs of the other age-groups are reckoned. An allowance of 2,400 calories net per day is considered adequate to meet the requirements of such an individual.

(*b*) The following supplements for muscular activity should be added to the basic requirements given above.

Light work: Up to 75 calories per adult per hour of work.

Moderate work: 75-150 calories per hour of work.

Hard work: 150-300 calories per hour of work.

Very hard work: 300 calories and upwards per hour of work.

Table 43. **Daily Allowances of Nutrients for Indians (Recommended by the Nutrition Expert Group in 1968)**

Group	Particulars	Net calories	Proteins (g)	Calcium (g)	Iron (mg)	Vitamin A: Retinol (μg) OR	Vitamin A: Carotene (μg)	Thiamine (mg.)	Riboflavin (mg.)	Nicotinic acid (mg.)	Ascorbic acid (mg)	Folic acid (μg)	Vit. B_{12} (μg)	Vit. D (I.U.)
Man														
	Sedentary work	2400	55[a]	0.4-0.5	20	750	3000	1.2	1.3	16	50	100	1	
	Moderate work	2800						1.4	1.5	19				
	Heavy work	3900[a]						2.0	2.2	26				
Woman														
	Sedentary work	1900	45[a]	0.4-0.5	30[a]	750	3000	1.0	1.0	13	50	100	1	
	Moderate work	2200						1.1	1.2	15				
	Heavy work	3000						1.5	1.7	20				
	Pregnancy (second half of pregnancy)	+300	+10[a]	1.0	40[b]	750	3000				50	150–300[a]	1.5	
	Lactation (upto 1 year)	+700	+20[a]		30[a]	1150	4600	+0.2 +0.4	+0.2 +0.4	+2 +5	80	150		
	Infants 0–6 months	120	2.3–1.8/kg	0.5–	1.0mg.	400	—				30	25	0.2	200
	7–12 „	/ kg	1.8–1.5/kg	0.6[a]	/kg	300	1200							
Children														
	1 year		17					0.6	0.7					
	2 years	1200	18							8				
	3 years		20	0.4–	15–20	250	1000							
	4– 6 years	1500	22	0.5		300	1200	0.8	0.8	10				
	7– 9 years	1800	33			400	1600	0.9	1.0	10				
	10–12 years	2100	41			600	2400	1.0	1.2	14				
Adolescents														
	13–15 years Boys	2500	55	0.6-0.7	25	750	3000	1.3	1.4	17	30–50	50–100	0.5–1.0	
	Girls	2200	50		35			1.1	1.2	14				
	16–18 years Boys	3000	60	0.5-0.6	25	750	3000	1.5	1.7	21				
	Girls	2200	50		35									

FOOTNOTES TO THE TABLE 43—DAILY ALLOWANCES OF NUTRIENTS FOR INDIANS

1. Calories

(*a*) Calorie allowance for heavy work does not include work under special conditions like high altitude.

2. Proteins

(*a*) Adult allowance corresponds to 1g/kg. of dietary protein of NPU 65.

(*b*) Infant allowance during 0–6 months is in terms of milk proteins. During 7–12 months; part of protein intake will be in the form of milk and supplementary feeding will be derived from vegetable proteins. Total daily protein allowance is calculated from the ideal weight. Protein allowance during infancy will be—

0–3 months	2.3 g/kg.
3–6 months	1.8 „
6–9 months	1.8 „
9–12 months	1.5 „

(*c*) Allowances for children and adolescents have been computed using bodyweights as obtained in well nourished group and assuming NPU of 50–60 for the dietary proteins.

3. Calcium

In the absence of precise information on calcium requirement of different groups, a range of allowance has been suggested.

(*a*) Calcium allowance for infants 0–6 months will be for artificially fed infants. Calcium intake from breast milk will, however, satisfy the needs of breast fed infants upto 6 months.

4. Iron

(*a*) This allowance of 30 mg. iron is for adult woman during her premenopausal period. For the post menopausal women iron allowance is the same as for man.

(*b*) This allowance for pregnant women will be throughout pregnancy.

(*c*) This allowance is for lactating woman who is not menstruating. If a woman is lactating and also menstruating, her iron allowance will be 35 mg/day.

5. Vitamin A

Dietary allowance for vitamin A is given in terms of retinol (vitamin A alcohol) and β–carotene. Either of these is used depending upon the dietary source of vitamin A. The factor to be used to convert β–carotene to retinol is : 1 μg β–carotene=0.25 μg of retinol (vitamin A).

If the diet contains both vitamin A and β–carotene, its content can be expressed as retinol using the following formulae :

(i) Retinol content μg=μg retinol+μg β–carotene×0.25, if the retinol and β–carotene contents of foods are given as μg in food composition tables.

(ii) Retinol content (μg)=vit. A (IU)×0.3+β–carotene (IU)× 0.15 if vitamin A and carotene values are given in terms of I.U.

6, 7, 8. Thiamine, Riboflavin and Nicotinic acid

Daily allowances of these three vitamins are related to calorie intake, the basic allowances per 1000 calories are Thiamine—0.5 mg. Riboflavin—0.55 mg. and Niacin—6.6 mg. (60 mg. tryptophan being equal to 1 mg. of niacin.)

Niacin equivalents in a diet are computed as follows :

$$\text{Niacin equivalents (mg)} = \text{Niacin content (mg)} + \frac{\text{Tryptophan content (mg)}}{60}.$$

9. Folic acid

Dietary allowance of folic acid will be in terms of free folic acid (*L. Casei* activity) present in foods.

(i) Folic acid requirement appears to be considerably increased during pregnancy. Since the exact requirement is not known, a range rather than a single figure has been suggested for the daily allowance of folic acid during pregnancy.

10. Vitamin B_{12}

Vitamin B_{12} is derived entirely from foods of animal origin.

11. Vitamin D

Since the exact requirement of vitamin D is not known, an arbitrary allowance of 200 I.U./day is made. This allowance is in addition to some amount of Vitamin D that might be derived from exposure to sunlight.

12. Fat

Since human requirement of fat is not known, no specific allowance is recommended. A desirable range for fat in the diet is, however, indicated. Diet should contain at least 15 g. fat derived from vegetable oils like sesame, safflower or groundnut. It is also desirable that calories derived from fat in the daily diet should not exceed 30 per cent of total calories.

The FAO Committee on calorie requirements recommended that for persons living in tropical climates, a reduction of 10 per cent should be made in the above allowances. The approximate calorie requirements of individuals of different ages living in tropical climates are given in Table 43.

Examples of different types of activities are given below:

Light work: Writing, typing, tailoring.

Moderate work: Walking, shoe-making, carpentry, light engineering work.

Hard work: Cycling, heavy carpentry, light blacksmithing, stone mason's work, ploughing, sawing wood, harvesting.

Very hard work: Coal mining, heavy blacksmithing, earth work, carrying heavy loads, wood cutting.

Protein

Animal proteins, in general, possess a higher nutritive value than vegetable proteins. Combinations of cereal, pulse and oilseed proteins possess a high nutritive value. The protein requirements of adults can be met by a mixture of cereal, oilseed and pulse proteins. For children and pregnant women, however, about 25-50 per cent of the dietary proteins should be derived from milk and other animal foods. *Milk, besides being an important source of animal protein, also supplies other dietary essentials like, calcium, vitamin A, riboflavin and vitamin* B_{12}.

Table 44. **Summary of dietary allowances based on the recommendations of British Medical Association, 1950**

	Calories	Protein (g.)	Calcium (g.)	Iron (mg.)	Vitamin A and carotene (i.u.)	Vitamin B_1 (mg.)	Riboflavin (mg.)	Nicotinic acid (mg.)	Vitamin C (mg.)
Man									
Sedentary	2500	69	0.8	12	5000	1.0	1.5	10	30
Moderately active	3000	82	0.8	12	5000	1.2	1.8	12	30
Active	3500	96	0.8	12	5000	1.4	2.1	14	30
Very Active	4250	117	0.8	12	5000	1.7	2.6	17	30
Woman									
Sedentary	2100	58	0.8	12	5000	0.8	1.3	8	30
Moderately active	2500	69	0.8	12	5000	1.0	1.5	10	30
Active	3000	82	0.8	12	5000	1.2	1.8	12	30
Very active	3750	103	0.8	12	5000	1.5	2.2	15	30
Pregnancy (latter half)	2750	96	1.5	15	6000	1.1	1.6	11	40
Lactation	3000	105	2.0	15	8000	1.2	1.8	12	50
Child									
Under 1 year	800	28	1.0	6	3000	0.3	0.5	3	10
1–3 years	1300	46	1.0	7	3000	0.5	0.8	5	15
4–6 years	1600	56	1.0	8	3000	0.6	1.0	6	15
7–9 years	1950	68	1.0	10	3000	0.8	1.2	8	20
10–12 years	2450	86	1.2	12	3000	1.0	1.5	10	25
Boy									
13–15 years	3150	116	1.4	15	3000	1.3	1.9	13	30
16–20 years	3400	119	1.4	15	5000	1.4	2.1	14	30
Girl									
13–15 years	2750	96	1.3	15	3000	1.1	1.6	11	30
16–20 years	2500	88	1.0	15	5000	1.0	1.5	10	30

Table 11. **Food and Nutrition Board, National Academy of Sciences, National Research Council**
Recommended Daily Dietary Allowances, 1963

Designed for the maintenance of good nutrition of practically all healthy persons

	Age Years from-to	Weight kg. (lbs)	Height cm (in)	Calories	Protein (gm)	Calcium (gm)	Iron mg.	Vitamin A value I.U.	Thiamine mg.	Riboflavin mg.	Niacin mg.	Ascorbic acid mg.	Vitamin D I.U.
Men	18–35	70 (154)	175 (69)	2900	70	0.8	10	5000*	1.2	1.7	19	70	
	35–55	70 (154)	175 (69)	2600	70	0.8	10	5000	1.0	1.6	17	70	
	55–75	70 (154)	175 (69)	2200	70	0.8	10	5000	1.9	1.3	15	70	
Women	18–35	58 (128)	163 (64)	2100	58	0.8	15	5000	0.8	1.3	14	70	
	35–55	58 (128)	163 (64)	1900	58	0.8	15	5000	0.8	1.2	13	70	
	55–75	58 (128)	163 (64)	1600	58	0.8	10	5000	0.8	1.2	13	70	
	Pregnant	(2nd & 3rd trimester)		+200	+20	+0.5	+5	+1000	+0.2	+0.3	+3	+30	400
	Lactating			+1000	+40	+0.5	+5	+3000	+0.4	+0.6	+7	+30	400
Infants	0–1	8 (18)		Kg.×115	Kg.×2.5	0.7	Kg.×1.0	1500	0.4	0.6	6	30	400
				±15	±0.5								
Children	1–3	13 (29)	87 (34)	1300	32	0.8	8	2000	0.5	0.8	9	40	400
	3–6	18 (40)	107 (42)	1600	40	0.8	10	2500	0.6	1.0	11	50	400
	6–9	24 (53)	124 (49)	2100	52	0.8	12	3500	0.8	1.3	14	60	400
Boys	9–12	33 (72)	140 (55)	2400	60	1.1	15	4500	1.0	1.4	16	70	400
	12–15	45 (98)	156 (61)	3000	75	1.4	15	5000	1.2	1.8	20	80	400
	15–18	61 (134)	172 (68)	3400	85	1.4	15	5000	1.4	2.0	22	80	400
Girls	9–12	33 (72)	140 (55)	2200	55	1.1	15	4500	0.9	1.3	15	80	400
	12–15	47 (103)	158 (62)	2500	62	1.3	15	5000	1.0	1.5	17	80	400
	15–18	53 (117)	163 (64)	2300	58	1.3	15	5000	0.9	1.3	15	70	400

Table 46. **Standard Nutritional Requirements for the Japanese Classified into ages, sexes and types of labour**

Classification	Calories Cal.	Protein g.	Calcium gm.	Iron mg.	Vitamin A I.U.	Vitamin B_1 mg.	Vitamin B_2 mg.	Niacin mg.	Vitamin C mg.	Vitamin D I.U.	Salt g.
Male (56 kg.)											
Light labour	2200	70	0.8	10	4000	1.1	1.1	11	65	400	15
Medium ,,	2500	80	0.8	10	4000	1.3	1.3	13	65	400	15
Heavy ,,	3000	95	0.8	10	4000	1.5	1.5	15	65	400	20
Hard ,,	3000	110	0.8	10	4000	1.8	1.8	18	65	400	20
Severe ,,	4000	120	0.8	10	4000	2.0	2.0	20	65	400	25
Female (49 kg)											
Light labour	1800	60	0.8	10	4000	0.9	0.9	9	60	400	15
Medium ,,	2000	70	0.8	10	4000	1.1	1.1	11	60	400	15
Heavy ,,	2400	75	0.8	10	4000	1.2	1.2	12	60	400	20
Hard ,,	2800	85	0.8	10	4000	1.4	1.4	14	60	400	20
Pregnant Women											
First half	2400	85	1.0	12	5000	1.5	1.5	15	80	400	15
Second ,,	2700	95	1.5	15	5000	1.8	1.8	18	100	400	15
Nursing women	3000	100	2.0	15	7000	2.0	2.0	20	150	400	20
Children under 13											
under 1	700	25	1.0	6	1500	0.4	0.4	4	25	400	1
1 to 3	1200	45	1.0	7	2000	0.6	0.6	6	30	400	3
4 to 6	1550	55	1.0	8	2500	0.8	0.8	8	40	400	6
7 to 9	1800	65	1.0	9	3000	0.9	0.9	9	55	400	8
10 to 12	2000	70	1.2	10	4000	1.0	1.0	10	70	400	10
Youth over 13											
Male 13–15	2450	90	1.4	13	4000	1.3	1.3	13	80	400	12
16–20	2650	95	1.4	13	5000	1.3	1.3	13	90	400	15
Female 13–15	2200	80	1.3	13	4000	1.1	1.1	11	75	400	12
16–20	2200	80	1.0	13	5000	1.1	1.1	11	75	400	15

Fat

No standards for the requirements of fat are available. The following approximate fat requirements may be useful in formulating balanced diets.

Adults . . 5-10 per cent of total calories in the diet from fat.
Children . . 10-15 per cent of total calories in the diet from fat.
Infants . . 15-30 per cent of total calories in the diet from fat.
The minimum fat requirement is estimated to be 15 g. per day.

Calcium

The figures given in Table 43 show *that the calcium requirements of children are equal to or higher than that of adults.* Hence the diets of children should include larger amounts of foods rich in calcium such as milk, ragi, green leafy vegetables etc., than that of adults.

Phosphorus

The requirement of phosphorus is closely related to that of calcium. It is generally agreed that the phosphorus requirement is about 20 per cent higher than that of calcium. A large part of the phosphorus present in cereals, pulses and nuts is in the form of *phytin.* Only 40-60 per cent of *phytin phosphorus* is available to the human body. Further, *phytin phosphorus* interferes with the absorption of dietary calcium and iron. On the other hand, the phosphorus present in milk is well utilised by human beings. It is for this reason that the diets of children should include large amounts of milk which is rich in available calcium and phosphorus.

Iron

The daily requirements range from 6-30 mg. depending on age and the physiological state of the individual. Women require more iron than men. Iron requirements of women are further increased during

pregnancy and lactation. Iron present in foods of vegetable origin is not well utilised by human beings as compared to that present in animal foods.

Other elements

Besides calcium, phosphorus and iron, a large number of other elements are also required. These are sodium, potassium, magnesium, manganese, copper, cobalt, zinc, iodine, etc. Well-balanced diets of the type given in Chapter XXII will provide adequate amounts of the above elements.

Vitamin A

The average diets contain both preformed vitamin A and carotene. While vitamin A is almost completely absorbed from the diet, carotene is less well absorbed. The absorption of carotene ranges from 20-50 per cent, depending on the fat content of the diet. Since the major portion of the vitamin A activity in Indian diets is contributed by carotene, a high allowance of 3000 μg. has been suggested for adults. Vitamin A requirements are increased during pregnancy and lactation. The diets of young children should contain some preformed vitamin A from milk, butter, ghee and fish liver oils.

Vitamin B_1

Vitamin B_1 requirements range from 0.4 to 1.8 mg. depending on age and physical activity. The quantity of vitamin B_1 required varies with the energy requirements, as this vitamin is concerned in carbohydrate metabolism. The optimum level of vitamin B_1 per 1000 calories has been suggested as 0.4-0.5 mg. Whole cereals, oilseeds, nuts and pulses are the most important sources of vitamin B_1 in the diets of children and adults, while milk is the main source of vitamin B_1 in the diets of infants.

Riboflavin

As in the case of vitamin B_1 the amount required is proportional to the calorie intake. The requirements of riboflavin vary from 0.6 to 2.0 mg. depending on age and physical activity. The optimum level of riboflavin in the diet per 1000 calories has been suggested as 0.5—0.6 mg. Milk, liver, and eggs are the richest sources of riboflavin. Cereals, pulses and green leafy vegetables are important sources of riboflavin in the diets of older children and adults in India, while milk is an important source in the diets of infants and young children.

The average Indian diet is deficient in riboflavin. This can be made up by the incorporation of half to one ounce of Indian Multipurpose food (Chapter XV) in the diet.

Nicotinic acid

The nicotinic acid requirements vary from 4 to 18 mg. depending on age and physical activity. As in the case of vitamin B_1 and riboflavin, the nicotinic acid requirement is proportional to the calorie intake. The optimum quantity of nicotinic acid in the diet per 1000 calories has been suggested as 4-5 mg. Cereals are the most important sources of nicotinic acid in average Indian diets.

Vitamin C

The average requirements of vitamin C range from 20-70 mg. depending on age and physiological state. The requirements can be readily met by the inclusion of leafy vegetables and cheap fruits e.g., *amla* and guava in the diet.

Vitamin D

The body obtains vitamin D from two sources; (1) food and (2) sunlight. The requirements of vitamin D in temperate climates are 400 International Units for

adults and children. Since exposure to sunlight produces vitamin D in the body, persons living in tropical countries may derive considerable amounts of vitamin D from this source and hence may need only about 200 units from food.

Other vitamins

Balanced diets given in Chapter XXII will provide adequate amounts of all other vitamins.

XX. FEEDING OF NORMAL INFANTS

Human milk is universally regarded as the ideal food for the feeding of infants during the early months. Yet, owing to various causes, an infant may not derive adequate nutrition from the mother and feeding with mammalian milk may be necessary. Cow's milk is commonly used in different countries for the feeding of infants and children. In India, in addition to cow's milk, buffalo's milk is also used to some extent in certain provinces. The milk of each species differs from that of others in the relative amounts of proximate principles, mineral constituents, vitamins and also in physical properties and digestibility. The use of processed milk foods in the feeding of infants is also on the increase in different parts of the world. For the successful feeding of infants with cow's or buffalo's milk, a knowledge of the nutritional requirements and the digestive capacity of the infant is necessary. The present section deals with the problems involved in the artificial feeding of infants with fresh mammalian milk and with processed infant foods.

Nutritional requirements of infants

The nutritional requirements of infants up to one year are given in Table 47. The milk used should meet the essential requirements for the nourishment of the

Table 47. **Daily dietary requirements of infants**

Age (months)	Calories	Protein (g)	Calcium (g)	Iron (mg)
1–3	100/kg	3.0/kg	0.3	3
4–9	100/kg	2.5/kg	0.5	4
10–12	100/kg	2.0/kg	0.6	6

Table 47. (*Continued*)

Age (months)	Vitamin A (I.U.)	Thiamine (mg)	Riboflavin (mg)	Niacin (mg)	Ascorbic acid (mg)	Vitamin D (I.U.)
1–2	1500	0.2	0.3	3	10	400
4–9	1500	0.3	0.5	4	15	400
10–12	1500	0.4	0.6	5	20	400

child. Besides providing the requirements of proteins, fats, carbohydrates, minerals and vitamins, the feed should be free from harmful bacteria and should be readily digestible.

Cow and buffalo milk formulae

The nutritional requirements of normal infants may be met by the use of simple mixtures of whole boiled cow's milk or partially skimmed or toned buffalo's milk, sugar and water, together with food supplements containing vitamin D, ascorbic acid and iron.

The chemical composition of human, cow's and buffalo's milk is given in Table 78. Whole buffalo's milk is rich in fat and hence is not suitable as such for feeding infants. It should be partially skimmed or *toned. Toned buffalo's milk can be readily prepared in the home by mixing equal quantities of pure buffalo's milk and milk reconstituted from skimmed milk powder.* Infants vary much in their ability to digest undiluted boiled milk. Dilution of the milk serves to make it more readily digestible and, at the same time, permits a more generous fluid intake. Dilution is required only for the young infant. Undiluted boiled milk usually can be digested without difficulty at seven or eight months of age. The quantities of milk, water and sugar required for infants

of age varying from 1 to 12 months are given in Table 48. In addition to this, the infant up to the age of 6 months requires a supplement of fruit juice (preferably orange or tomato juice) as a source of vitamin C and shark liver oil as a source of vitamins A & D. For infants older than 6 months, small amounts of cooked and mashed green leafy vegetables, cereals and fruit pulp should be introduced in gradually increasing amounts as shown in Table 48. When both cow's and buffalo's milks are not available, vegetable milk prepared from soya bean according to the method given in Chapter XV, can be used for infants aged above six months.

Table 48. **Feeding of infants from 1 to 12 months**
(Requirements per day)

Age (months)	Approx. body weight (kilogram)	Cow's[1] milk or partially skimmed buffalo milk (ozs.)	Water (ozs.)	Sugar (ozs.)	Number of feeds per day	Fruit[2] juice (ozs.)	Shark[3] liver oil (teaspoon)	Fruit[4] and vegetable pulp (ozs.)	Cereals[5] (ozs.)
1	3.0	10	5	½	6	½	½	...	...
2	3.5	12	6	½	6	½	½	...	...
3	4.0	14	7	¾	6	1	½	...	...
4–5	4.5–5.0	16–18	8	1	5	1½	½	...	...
6–7	5.5–6.0	20–24	8	1¼	5	2	¾	½	...
8–9	6.5–7.0	22	8	1½	5	2	1	1	½
10–11	7.5–8.0	26	8	1¾	5	3	1	1½	1
12	8.5	28	8	2	5	3	1	1½	1½

[1] If the infant is receiving breast milk, the quantity of cow's milk and the number of feeds should be reduced.

[2] Orange or tomato juice may be given as a source of vitamin C.

[3] Shark liver oil supplies vitamins A and D.

[4] Fruit pulp prepared from ripe banana, mango and papaya and pulps prepared from tender cooked leafy vegetables may be given.

[5] Bread or cereal flour cooked in the form of porridge or pudding with milk and sugar may be given.

Processed infant foods

Whole milk powder prepared from cow's milk contains about 26 per cent protein and 26 per cent fat. Infant foods available on the market have widely varying protein (14 to 27 per cent) and fat (10-25 per cent) contents. They may be grouped broadly as follows: (1) *Whole milk food* (Full cream milk powder) with added vitamin D and iron (2) *Half cream milk food* with added vitamin D and iron and (3) *Humanised milk food* with added carbohydrate and the proportion of protein altered more or less to resemble those of human milk. In view of the fact that the protein and fat requirements of infants under tropical conditions are somewhat lower than the standards suggested for infants in temperate climates, an infant food with a protein content of 20-22 per cent and fat content of 18 per cent may be more suited for infants in tropical countries. Recently, a process for the preparation of infant food in India has been standardised at the Central Food Technological Research Institute, Mysore. An infant food ('Amul infant food'), prepared according to the above formula, is being manufactured and marketed by the Kaira Co-operative Milk Producers' Union, Anand. The chemical composition of some common proprietary infant foods as compared with 'Amul infant food' is given in Table 49.

The main advantages of dried milk foods over fluid milk are: (*a*) the ready availability of the product (*b*) the ease of transportation (*c*) the dependability of the hygienic and nutritional quality of the product (*d*) the long keeping quality and (*e*) the unvarying chemical composition and freedom from adulteration. Most of the infant foods are fortified with vitamin D and some, also with iron. They do not, however, contain sufficient amounts of vitamin C. *So artificially fed babies require a supplement of vitamin C.* For feeding infants, the proprietary infant foods are usually reconstituted with 8 to 10 times their weight of hot water depending on the age of the infant.

'able 49. **The composition of some proprietary infant foods**[1]

'roduct	Fat %	Protein %	Carbo-hydrate %	Mineral Salts %	Moisture %	Description
ıul infant ood[2]	18.5	21.5	52.4	4.8	2.8	A milk food with reduced fat.
v and Gate 'ull cream ood[3]	27.3	26.6	37.6	6.0	2.5	A standardised unmodified milk food suitable for feeding normal infants up to 9 months.
w and Gate Half cream 'ood	15.0	20.0	58.0	4.5	2.5	A milk food with reduced fat for infants up to 3 months and older fat-intolerant infants.
Glaxo	26.5	24.9	38.5	5.6	2.9	Dried milk food (unmodified).
Lactogen	19.0	22.0	51.5	5.0	2.5	Dried milk food

[1] W. C. Harvey and H. Hill (1948), *Milk Products*, Second Edition, p. 321, H. K. Lewis and Co. Ltd., London.

[2] Prepared according to the formula developed by C. F. T. R. I. at the factory of the Kaira Co-operative Milk Producers' Union Ltd., Anand. Chandrashekara, M. R., Swaminathan, M., Bhatia, D. S., and Subrahmanyan, V., 1957. *Indian Dairyman*, *IX*. 276.

[3] The composition of many common proprietary infant foods is given in *Hutchinson's Food and the Principles of Dietetics*, revised by V. H. Mottram and G. Graham, 1948, Tenth Edition, p. 560, Edwin Arnold & Co., London.

XXI. FEEDING OF WEANED INFANTS AND YOUNG CHILDREN

Infants are generally weaned in India at the age of about 9 to 12 months. Infants belonging to the low income groups of the population are generally fed after weaning on cooked cereals and cereal gruels. These, by themselves, do not supply sufficient amounts of proteins, minerals and vitamins. Sufficient amounts of milk and protein rich supplementary foods are not normally included in the diet. Milk is the ideal food supplement to the diets of weaning infants. When milk is not available in adequate amounts, the deficiencies in the diet can be made up by including sufficient quantities of split pulses, vegetable milk and curds prepared from groundnut or soya bean, nutritionally balanced malt food or Indian multipurpose food. A number of feeding experiments conducted in different parts of the world have demonstrated that it is possible to prepare an adequate diet for weaned infants and young children based on cereals, pulses, nuts and oilseeds and vegetables, when sufficient quantity of milk is not available. Balanced diets, at moderate costs, for the feeding of weaned infants are given in Table 50.

Since the capacity of infants to digest coarse food is limited, the food preparations must be well cooked and be free from fibrous material. The role of different foods in the diet of weaned infants is described below:

Cereals and pulses

The feeding of cereals as the baby's first solid food has been a custom for many centuries. Many pediatricians are convinced that cereals add something of importance to the diet and babies who receive them along with a milk diet thrive better than those who do not. The cereal and pulse flours can be mixed and made into 'Idli', pudding or thick porridge and given to the

50. **Balanced diets for weaned infants and preschool children** (grams/day/caput)

odstuffs	Balanced diets at Moderate costs				Balanced diets at low costs			
	1–2 years		3–5 years		1–2 years		3–5 years	
	V	NV	V	NV	V	NV	V	NV
als (rice, jowar, heat, & Bajra)	75	75	100	100	50	50	75	75
i	50	50	75	75	75	75	100	100
fed Bengal gram	25	25	25	25	25	25	50	50
ses	25	25	50	50	50	50	50	50
een leafy vege-tables	50	50	75	75	50	50	75	75
oots and Tubers	30	30	30	30	30	30	30	30
ruits	30	30	30	30	30	30	30	30
Milk	300	200	300	200	150	100	150	100
ish and Meat	—	10	—	10	—	10	—	10
Eggs	—	10	—	10	—	10	—	10
Fats and oils (including Butter and Ghee)	30	50	30	30	15	15	15	15
Sugar and Jaggery	50	30	50	50	30	30	30	30

infant after the addition of sugar or salt. Investigations carried out at the Nutrition Research Laboratories Coonoor (now at Hyderabad) have shown that puffed Bengal gram dhal flour is a good supplement to the diets of young children.

Green leafy vegetables

Vegetables, particularly the green leafy vegetables, supplement the infant's diet moderately in various nutritional essentials, including iron, carotene and vitamin C. The vegetables, after being cooked, should be finely divided by mashing and then fed. Many of the commonly used green leafy vegetables, carrot, tender beans and green peas may be used singly or in

combination. In western countries, many ready-to-serve vegetable preparations are available in cans. Though these are convenient for feeding babies, they are costly and hence beyond the means of the poor people. In starting the feeding of mashed vegetables, a small amount is given at first, say two tea-spoonfuls and the amount is gradually increased to about one ounce per day as the infant grows. After the age of one year, the baby should receive daily some quantity of cooked and mashed green leafy vegetables. In addition to the supply of nutrients, vegetables contain small amounts of cellulose materials which help in the normal bowel movements of the infants.

Fruits

Fruits belong to the class of protective foods as they are rich sources of vitamin C. Further, the citric acid and its salts present in fruit juices may help in the absorption of calcium. Fruits contain fair amounts of easily assimilable forms of sugars and appreciable quantities of essential minerals. Fruits, in addition to their nutritive value, may also serve to stimulate appetite and aid in the digestion of milk and other protein foods. They may also exert a beneficial effect on the intestinal microflora, thereby aiding in the absorption of nutrients. Fruit juice and fruit juice concentrates are widely given to infants even from the age of 2 months. Orange and tomato juices are the most popular for this purpose. The addition of fruits and fruit juices to the diet relatively early in infancy is desirable. Fruits commonly used are banana, mango, papaya, tomato and orange. In starting the feeding of fruits, the fruit pulp should be given in small amounts from the 8th month onwards and the quantity is gradually increased as the infant grows. Certain fruits like ripe banana and mashed cooked apples are being extensively used in the treatment of diarrhoea in children.

Supplementary value of processed protein foods to the diets of pre-school children

Since the diets consumed by a large majority of weaned infants and pre-school children in India and other developing countries are lacking in protein rich and protective foods, there is urgent need for the production of processed protein foods based on vegetable proteins for use as supplements to the diets of weaned infants and pre-school children. The studies carried out at the Central Food Technological Research Institute, Mysore, have shown that a daily supplement of 2 ounces of Indian multipurpose food formula C or nutritionally balanced malt food over a period of 9 months to weaned infants brought about highly significant increases in heights, weights and general health. Similar studies carried out at the Nutrition Research Laboratories, Hyderabad have shown that the growth rates of weaned infants and pre-school children receiving protein foods based on 3:1 parts of groundnut flour and Bengalgram flour (Mysore food A) or 4:1 blend of parched chickpea and skim milk powder were similar to that observed in children receiving skim milk powder. The results are given in Table 51.

Table 51. **The effect of supplementary protein food on the growth rate of undernourished weaned infants and pre-school children**

Expt. No.	Diet and Protein supplement	Duration of expt. (Months)	Increase in Weight (kg)	Increase in Height (cm)
I	Rice diet (control)	9	0.74	4.30
	Rice diet+Indian Multipurpose food (formula C)	9	1.95	6.38
	Rice diet+malt food	9	1.91	5.46
II	Basal diet+skim milk powder	12	1.66	8.09
	Basal diet+Mysore Food A	12	2.00	7.36
	Basal diet+Bengalgram+skim milk powder	12	1.10	8.36

XXII. BALANCED DIETS FOR CHILDREN, ADULTS AND INDUSTRIAL AND AGRICULTURAL WORKERS

A balanced diet is one which contains the various foodstuffs, such as energy yielding foods, body building foods and protective foods, in the correct proportions so that an individual is assured of obtaining the minimum daily requirements of all the nutrients. The components of a balanced diet will naturally differ according to age, sex, physical activity, economic status and the physiological state viz., pregnancy, lactation, etc. The minimum requirements of dietary essentials for different age groups are given in Table 43. An ill-balanced diet does not

Table 52. **Balanced and ill-balanced diets**

Foodstuff	Adult		Child (3 years)	
	Ill-balanced diet (oz)	Balanced diet (oz)	Ill-balanced diet (oz)	Balanced diet (oz)
Cereals	20	14	6	3
Ragi, malted	...	...	...	1
Pulses	1	3	0.5	1
Groundnut, roasted	...	1	...	...
Green leafy vegetables	...	4	...	1
Roots and tubers (Potato, sweet potato, radish)	2	3	1	1
Non-leafy vegetables (Brinjal, green plantain, etc.)	2	3	1	...
Sugar and jaggery	2	2	1.5	1.5
Vegetable oils and fats	0.5	2	0.5	0.5
Milk	3	10	5	15
Meat and fish	...	2	...	...
Eggs	...	1	...	1
Fruits (Tomato, guava, *amla* etc.)	...	3	...	2

provide the minimum daily requirements of the various nutrients and hence an individual taking such a diet is sure to suffer from various degrees of malnutrition or deficiency diseases and his physical efficiency will also be very low.

Table 52 shows balanced diets for a moderately hard-working adult and a child 3 years old as compared with ill-balanced diets ordinarily consumed by the poorer sections of the population.

The nutritive value of the balanced and ill-balanced diets as compared with the daily dietary requirements is given in Table 53. It will be noted that:

(1) The ill-balanced diets lack in protective and protein-rich foods and hence are deficient in proteins, vitamin A, riboflavin, vitamin B_1 and calcium.

Table 53. **Nutritive value of ill-balanced and balanced diets as compared with the daily requirements**

Nutrients	Adult			Child (3 years)		
	Daily requirements	Ill-balanced diet	Balanced diet	Daily requirements	Ill-balanced diet	Balanced diet
Calories	3,000	3,000	3,300	1,000	963	1,117
Protein (g)	70	46	76	35	18.6	36.6
Fat (g)	50-60	62	85	20-40	20.4	38.4
Calcium (g)	1.0	0.35	1.14	0.7	0.30	0.78
Phosphorus (g)	1.2	0.78	1.62	0.7	0.36	0.78
Iron (mg)	20-30	9.8	38	8	8.7	11.4
Vitamin A (I.U.)	5,000	1,200	5,600	2,000	407	2,357
Thiamine (mg)	1.2	0.8	1.5	0.6	0.33	0.71
Riboflavin (mg)	1.0	0.4	1.0	0.7	0.31	1.02
Nicotinic acid (mg)	15.0	12.0	20.0	6.0	3.4	4.3
Vitamin C (mg)	15	12	68	30	12	39

(2) The balanced diets contain adequate quantities of protein-rich and protective foods and provide the minimum daily requirements of all the food factors.

(3) The diet of a child should contain more of protective foods and less of energy yielding foods than that of an adult.

Table 54. **Balanced diets for men**
(Ounces per day)*

Foodstuffs	Light work		Moderate work		Very hard work	
	V	NV	V	NV	V	NV
Cereals[1] (Rice, wheat or millets)	14	14	16	16	20	20
Pulses[3]	3	2	3	2	3	2
Groundnut, roasted	1	1	2	1	3	2
Bengal gram, puffed	1	...	1	...	1	...
Milk and curds[2,4]	10	5	10	5	10	5
Meat and fish	...	2	...	2	...	2
Eggs	...	1	...	1	...	1
Green leafy vegetables	3	3	3	3	3	3
Roots and tubers	4	4	4	4	4	4
Other vegetables	2	2	2	2	2	2
Fruits	2	2	2	2	2	2
Oils and fats	1	1	2	2	2	2
Sugar and jaggery	2	2	2	2	2	2

* One ounce=28.4 g. V=Vegetarian. NV=Non-Vegetarian.

[1] If sufficient quantities of cereals are not available, tapioca flour can be used to the extent of 3 to 4 ounces per day. Cereals should include 4 ounces of ragi, a millet rich in calcium.

[2] Vegetable milk and curds prepared at home according to the process given in Chapter XV can be used in place of curds from cow's or buffalo's milk.

[3] One ounce of Indian multipurpose food (Chapter XV) incorporated in the diet in place of one ounce of groundnut or pulses will provide extra amounts of protein, calcium and certain vitamins.

[4] Consumption of milk and other protective foods to a greater extent is desirable.

BALANCED DIETS AT MODERATE COSTS

Balanced diets for men

When recommending balanced diets for men, the degree of activity has to be borne in mind. A sedentary or light worker needs less calories than a moderately hard worker and a very hard worker needs much more than the former two. Balanced diets, at moderate costs for men of varying degrees of activities are given in Table 54.

Balanced diets for women

In the case of women, in addition to the degree of physical activity, other physiological factors such as pregnancy and lactation have also to be taken into consideration. An expectant mother needs more proteins, calcium, iron and vitamins, especially during the second half of pregnancy. A nursing mother needs more of all the nutrients than a normal woman as she has to feed the baby. Hence diets have to be modified according to their needs. Balanced diets at moderate costs for women are given in Table 55.

Balanced diets for children and adolescents

Since children and adolescents are continuously growing, their needs for nutrients increase as they grow. Hence the diets of children should contain greater amounts of protective foods than energy yielding foods. Balanced diets at moderate costs for children and adolescents are given in Tables 56 and 57.

Balanced diets for Industrial and Agricultural Workers

The problem of providing balanced diets for industrial and agricultural workers *at low cost* has been engaging the attention of nutrition workers in different countries. In view of their scarcity and high cost, protective and protein-rich foods such as milk, eggs, meat, fish and fruits cannot be included in adequate amounts in diets

of the low income groups. The diets should therefore include liberal amounts of pulses, groundnut and green leafy vegetables. Balanced diets suitable for industrial and agricultural workers are given in Table 58.

Table 55. **Balanced diets for women** (Ounces per day)*

Foodstuff	Light work		Moderate Work		Very hard work		Expectant mother		Nursing mother	
	V	NV	V	NV	V	NV	V	NV	V	NV
Cereals[1]	11	11	14	14	16	16	10	10	15	15
Pulses[3]	3	2	3	2	3	2	4	2	4	2
Groundnut, roasted	1	1	2	1	2	1	1	1	2	1
Gingelly (sesame) seeds	...	...	...	...	...	...	1	1	1	1
Bengal gram, puffed	1	...	1	...	1	...	2	1	2	1
Milk and curds [2,4]	10	5	10	5	10	5	20	12	20	12
Meat and fish	...	2	...	2	...	2	...	3	...	3
Eggs	...	1	...	1	...	1	...	1	...	1
Green leafy vegetables	3	3	3	3	3	3	4	4	4	4
Roots and tubers	4	4	4	4	4	4	2	2	2	2
Other Vegetables	2	2	2	2	2	2	2	2	2	2
Fruits	2	2	2	2	2	2	4	4	4	4
Oils and fats	1	1	1	1	1	1	1	1	1	1
Sugar and jaggery	2	2	2	2	2	2	2	2	2	2

* One ounce=28.4 g. V=Vegetarian. NV=Non-Vegetarian.

[1] Cereals should include 3 to 4 ozs. of ragi, a millet rich in calcium.

[2] If sufficient milk is not available, vegetable milk and curds prepared according to directions given in Chapter XV may be consumed with advantage.

[3] Incorporation of one ounce of Indian multipurpose food (Chap. XV) in the diet in place of one ounce of groundnut or pulse will provide extra amounts of protein, calcium and certain vitamins.

[4] Consumption of milk and other protective foods to a greater extent is desirable.

Table 56. **Balanced diets for children** (Ounces[1] per day)

Foodstuff	3 to 4 years		5 to 6 years		7 to 8 years		9 to 10 years		11 to 12 years	
	V	NV	V	NV	V	NV	V	NV	V	NV
Cereals[2]	5	5	7	7	9	9	11	11	12	12
Pulses[6]	1	1	1.5	1.5	2	2	2	2	2	2
Groundnut, roasted	...	...	1	...	1	1	2	1	2	1
Gingelly (sesame) seeds	0.5	0.5	0.5	0.5	1	1	1	1	1	1
Bengal gram, puffed	1	...	1	...	1	...	2	...	2	1
Milk and curds[3,5]	20	12	15	8	15	8	15	8	15	8
Meat and fish	...	1	...	2	...	2	...	2	...	2
Eggs	...	1	...	1	...	1	...	1	...	1
Green leafy vegetables	1.5	1.5	2	2	3	3	3	3	3	3
Roots, tubers and other vegetables	1	1	1	1	2	2	4	4	5	5
Fruits	3	3	3	3	3	3	3	3	3	3
Oils and fats[4]	0.5	0.5	0.5	0.5	0.5	0.5	1	1	1	1
Sugar and jaggery	2	2	2	2	2	2	2	2	2	2

V=Vegetarian. NV=Non-Vegetarian.

[1] One ounce=28.4 g.

[2] Cereals should include 1-2 ounce of ragi malt for children aged 3-6 years and 3-4 ounces of ragi for children aged 7-12 years.

[3] If sufficient milk is not available, vegetable milk and curds prepared according to the method given in Chapter XV can be given along with one teaspoonful of shark liver oil daily.

[4] Half the quantity as butter and ghee.

[5] Consumption of milk and other protective foods to a greater extent is desirable.

[6] Consumption of half to one ounce of Indian multipurpose food in place of an equal quantity of pulses will provide extra amounts of protein, calcium and certain vitamins.

Table 57. **Balanced diets for adolescent boys and girls**
(Ounces per day)

Foodstuff	Boys				Girls			
	13 to 16 years		17 to 21 years		13 to 16 years		17 to 21 years	
	V	NV	V	NV	V	NV	V	NV
Cereals[1]	15	15	18	18	14	14	15	15
Pulses[2]	3	2	3	2	3	2	3	2
Groundnut, roasted	2	1	2	1	2	1	2	1
Bengal gram, puffed	1	...	1	...	1	...	1	...
Milk and curds[3]	10	5	10	5	10	5	10	5
Meat and fish	...	2	...	2	...	2	...	2
Eggs	...	1	...	1	...	1	...	1
Green leafy vegetables	4	4	4	4	4	4	4	4
Roots and tubers	4	4	4	4	4	4	4	4
Other vegetables	4	4	4	4	4	4	4	4
Fruits	4	4	4	4	4	4	4	4
Oils and fats	2	2	2	2	2	2	2	2
Sugar and jaggery	2	2	2	2	2	2	2	2

V=Vegetarian. NV=Non-Vegetarian.

[1] Cereals should include 4 ounces of ragi, a millet rich in calcium.

[2] Consumption of one ounce of Indian multipurpose food in place of one ounce of pulses is desirable.

[3] When milk and curds are not available, vegetable milk and curds prepared according to the method given in Chapter XV can be used with considerable benefit.

Supplementary foods

Consumption of one ounce of multipurpose food (Chap. XV) in place of one ounce of pulses or groundnut will provide extra amounts of proteins, calcium, riboflavin and vitamin A.

Table 58. **Balanced diets for industrial and agricultural workers** (Ounces per day)

Foodstuff	Men				Women			
	Light work	Moderate work	Hard work	Very hard work	Light work	Moderate work	Hard work	Moderate work (Nursing mothers)
Rice or wheat[1]	8	9	10	11	7	8	9	9
Millets[2]	8	9	10	11	7	8	9	9
Pulses	2	2	2	2	2	2	2	2
Groundnut (roasted)	1	1	1	2	1	1	1	2
Bengal gram (puffed)	1	1	1	1	1	1	1	2
Green leafy vegetables	4	4	4	4	4	4	4	4
Roots, tubers and other vegetables	8	8	8	8	8	8	8	8
Oils and fats	1	1	1	1	1	1	1	1
Sugar and jaggery	1	1	1	1	1	1	1	1
Milk and curds[3]	4	4	4	4	4	4	4	4
Meat or fish	1	1	1	1	1	1	1	1
Indian multipurpose food	1	1	1	1	1	1	1	1

[1] Four ounces of cereals can be replaced by 4 ounces of tapioca flour or a blend of tapioca flour (75 parts) and groundnut flour (25 parts) if sufficient quantities of cereals are not available.

[2] Millets should include 4 ounces of ragi.

[3] When milk and curds are not available, vegetable milk and curds prepared according to the method given in Chapter X can be used with benefit.

Balanced diets recommended by the Nutrition Expert Group (ICMR), New Delhi

The Nutrition Expert Group of the ICMR, New Delhi, have recommended balanced diets suitable for

Indian conditions. In formulating these diets, the following criteria had to be borne in mind:

(1) The diets should be such as would conform to the prevailing dietary and culinary practices.

(2) The diets should be as inexpensive as possible.

(3) They should provide the essential nutrients in adequate quantities.

(4) They should be based on ingredients which are locally available and acceptable. The composition of the diets is given in Table 59-62.

Table 59. **Balanced diets for children**
(Recommended by the Nutrition Expert Group, ICMR, in 1968)

	Preschool children				School children			
	2–3 years		4-6 years		7-9 years		10–12 years	
	V (g)	NV (g)	V (g)	NV (g)	V (g)	NV (g)	V (g)	NV (g)
Cereals	150	150	200	200	250	250	320	320
Pulses	50	40	60	50	70	60	70	60
Green leafy vegetables	50	50	75	75	75	75	100	100
Other vegetables, Roots and tubers	30	30	50	50	50	50	75	75
Fruits	50	50	50	50	50	50	50	50
Milk	300	200	250	200	250	200	250	200
Fats and oils	20	20	25	25	30	30	35	35
Meat and fish, Eggs	...	30	...	30	...	30	...	30
Sugar and jaggery	30	30	40	40	50	50	50	50

V=Vegetarian. NV=Non-Vegetarian.

Table 60. **Balanced diets for adolescent boys and girls**
(Recommended by the Nutrition Expert Group, ICMR, in 1968)

	Boys				Girls	
	13–15 years		16–18 years		13–18 years	
	V (g)	NV (g)	V (g)	NV (g)	V (g)	NV (g)
Cereals	430	430	450	450	350	350
Pulses	70	50	70	50	70	50
Green leafy vegetables	100	100	100	100	150	150
Other vegetables	75	75	75	75	75	75
Roots and tubers	75	75	100	100	75	75
Fruits	30	30	30	30	30	30
Milk	250	150	250	150	250	150
Fats and oils	35	40	45	50	35	40
Meat and fish	...	30	...	30	...	30
Eggs	...	30	...	30	...	30
Sugar and jaggery	30	30	40	40	30	30
Groundnut	...	...	50*	50*	...	...

V=Vegetarian. NV=Non-Vegetarian.

* An additional 30 g. fats and oils can be included in the diet in the place of groundnuts.

Table 61. **Balanced diets for adult males**

(Recommended by the Nutrition Expert Group, ICMR, in 1968)

	Sedentary work		Moderate work		Heavy work	
	V (g)	NV (g)	V (g)	NV (g)	V (g)	NV (g)
Cereals	400	400	475	475	650	650
Pulses	70	55	80	65	80	65
Green leafy vegetables	100	100	125	125	125	125
Other vegetables	75	75	75	75	100	100
Roots and tubers	75	75	100	100	100	100
Fruits	30	30	30	30	30	30
Milk	200	100	200	100	200	100
Fats and Oils	35	40	40	40	50	50
Meat and fish	...	30	...	30	...	30
Egg	...	30	...	30	...	30
Sugar and jaggery	30	30	40	40	55	55
Groundnut	...	...	...	...	50*	50*

V=Vegetarian. NV=Non-Vegetarian.

* An additional 30 g. of fats and oils can be included in the diet in place of groundnut.

Table 62. **Balanced diets for adult females**

(Recommended by the Nutrition Expert Group, ICMR, in 1968)

	Sedentary work		Moderate work		Heavy work		Additional allowances during	
	V (g)	NV (g)	V (g)	NV (g)	V (g)	NV (g)	P* (g)	L* (g)
Cereals	300	300	350	350	475	475	50	100
Pulses	60	45	70	55	70	55	...	10
Green leafy vegetables	125	125	125	125	125	125	25	25
Other vegetables	75	75	75	75	100	100	...	...
Roots and tubers	50	50	75	75	100	100	...	...
Fruits	30	30	30	30	30	30	...	...
Milk	200	100	200	100	200	100	125	125
Fats and Oils	30	35	35	40	40	45	...	15
Sugar and jaggery	30	30	30	30	40	40	10	20
Meat and fish	...	30	...	30	...	30	...	...
Eggs	...	30	...	30	...	30	...	...
Groundnut	...	...	...	...	40†	40†	...	...

V=Vegetarian. NV=Non-Vegetarian.

P*=Pregnancy. L*=Lactation.

† An additional 25 g. of fats and oils can be included in the diet in the place of groundnuts.

XXIII. SCHOOL LUNCH AND ITS ROLE IN IMPROVING THE HEALTH OF CHILDREN

School lunch is a measure for improving the health and nutrition of children. The conference convened by FAO in 1947 recommended that even in countries where food supplies are short, school feeding should be pushed forward by giving it a high priority among measures for safeguarding and improving the nutrition of children. During recent years a great majority of schools in all Western Countries and Japan provide nutritious lunches for children. In India only a beginning in this direction has been made recently. It is to be hoped that in the course of next 10 years all children in schools will receive nutritious lunch based on regional food materials.

School lunch patterns in different countries

Experience has shown that school lunch programmes can be undertaken effectively both in food surplus and in food deficit countries. In the latter case they help to ensure that the best use is made of available foodstuffs. The composition of school lunches given in U.S.A. is given in Table 63.

A regional Nutrition Committee for South East Asia convened by FAO in 1943 at Philippines suggested the following general pattern for school lunch suitable for the region.

	Ounces/day/individual
Cereals	2.25
Pulses	0.25
Fish (rich in Ca)	0.25
Leafy vegetables	1.00
Oil	0.25
Salt	0.16

Table 63. **Composition of School Lunches in U.S.A.**

Constituent	Type A*	Type B†	Type C‡
Milk (whole)	½ pint	½ pint	½ pint
Fresh or processed meat, poultry, cheese or fish	2 ounces	1 ounce	...
Beans cooked	½ cup	½ cup	...
Egg	One	Half	...
Vegetables and fruits (raw, cooked or canned)	6 ounces	4 ounces	...
Bread	1 portion	1 portion	...
Butter or margarine	2 teaspoons	1 teaspoon	...

* Complete lunch, hot or cold, providing one-third to one-half of the day's nutritional requirement.

† A partially complete lunch, hot or cold, which is less adequate nutritionally.

‡ One-half pint of whole milk as a beverage.

A lunch of this type provides about 400 calories and about one-third the daily requirements of several nutrients.

The School Health Committee set up by the Government of India suggested a lunch of the following composition.

	Ounces/day/child
Cereals and millets	2.5
Pulses	1.0
Oils and fats	0.25
Leafy vegetables	1.0
Non-leafy vegetables	1.0

The Committee recommended that it is desirable to include a protein-rich supplement such as fish (0.5 ounces) or skim milk reconstituted (4 ounces) or Indian Multipurpose food (0.5 ounces) in place of 0.5 ounces of pulses.

Effect of supplementary Indian multipurpose food in improving the health of children

Studies carried out on school children in different countries have shown that supplementation of the diets of children with milk brings about a marked improvement in their growth and general health. In view of the shortage in the supply of milk in India, studies were carried out in the Central Food Technological Research Institute to assess the supplementary value of Indian multipurpose food (Chap. XV) to the diets of children. The results given in Table 64 clearly show that consumption of 2 ounces of Indian MPF daily over a period of 5 months brought about highly significant improvements in the growth of children.

Table 64. **Effect of MPF supplement on the growth of children**

Diet	Increase in Weight (kg)	Height (cm)
Basal rice diet (control)	0.45	0.7
Basal rice diet + Indian MPF (experimental)	1.19	2.44

XXIV. NUTRITION OF EXPECTANT AND NURSING MOTHERS

The nutritional requirements of women are increased markedly during pregnancy and lactation. The requirements recommended by various committees are given in Tables 43, 44, 45, 46.

Expectant mothers

Due to vomiting and loss of appetite during the early months of pregnancy, the food intake is generally reduced. Further additional nutrients are required for the growth of the foetus. The body of the baby weighing about 7 lb. at birth contains about 500 g. protein, 24 g. calcium and 14 g. phosphorus and 0.4 g. iron. It also contains varying quantities of different vitamins. Since a greater part of the increase in weight of the foetus takes place in the last 5 months of pregnancy, the approximate *daily retention* of nutrients in the body of the foetus will be 8 g. protein, 0.2 g. calcium and 4 mg. iron in the above period. In addition the mother retains additional protein (about 500 g.) in other tissues. Since only about 20-25 per cent of protein, and calcium and about 15 to 20 per cent of iron consumed in the diet are retained during pregnancy, the extra nutrient requirements in the diet to meet the actual needs will be proportionately higher. The *additional* nutrient requirements during pregnancy are given in Table 65.

Nursing mothers

The increased requirements during lactation are due to the milk secreted for feeding the baby. The quantity of milk secreted during the first year may vary from 500 to 800 ml and during the second year from 200 to 300 ml in India and other developing countries where breast

feeding of infant is continued for about 1-2 years. Mother's milk will provide the infant about 7 to 9 g. protein, 0.2 to 0.3 g. calcium and about 400 to 500 calories daily. Since only about 20-25 per cent of protein and calcium and about 15 to 20 per cent of iron consumed in the diet are retained in milk, the extra nutrient requirements will be proportionately higher. Data regarding the *additional* nutrient requirements of nursing mothers are given in Table 65.

Table 65. **Additional daily nutritional requirements of expectant and nursing mothers**

Nutrient	Expectant* Mothers (Pregnancy latter half)	Nursing* mothers
Calories	200	1000
Protein (g)	20	40
Calcium (g)	0.5	0.5
Iron (mg)	5	5
Vitamin A (I.U.)	1000	3000
Thiamine (mg)	0.2	0.4
Riboflavin (mg)	0.3	0.6
Niacin (mg)	3	7
Ascorbic acid (mg)	30	30
Vitamin D (I.U.)	400	300

* Additional requirements.

Balanced diets for expectant and nursing mothers

Balanced diets suitable for expectant and nursing mothers are given in Table 55 and 62. Inclusion of the following supplementary foods will make up the deficiencies in the average poor Indian diets; pulses, 2 ounces; roasted groundnut, 2 ounces, green leafy vegetables, 4 ounces; and Indian multipurpose food, 2 ounces.

XXV. NUTRITION OF INDUSTRIAL WORKERS

A large majority of the low income groups of the population suffer from undernutrition and malnutrition. The development of agriculture and industry which alone would ensure a regular and adequate food supply and income for the people is hampered by the low working efficiency of the agricultural and industrial workers due partly to undernutrition and malnutrition.

Malnutrition among industrial workers

The main causes for the high incidence of malnutrition among industrial workers are (1) Inadequate income (2) Poor housing in insanitary surroundings resulting in high incidence of infection and infestation which impair their health. (3) Ignorance regarding the nutritional needs and (4) Non-availability of low cost protective foods in adequate amounts. The incidence of anaemia, certain metabolic disorders and mild nervous disorders are fairly high among them.

Nutritional requirements of industrial workers

The requirements of various dietary essentials for men and women engaged in work of varying degrees of severity are given in Table 43. Balanced diets suitable for industrial workers are given in Table 58 and 61.

Diet surveys have shown that the diets consumed by industrial workers in India are inadequate and lack in protective foods. The diets are deficient in calories, proteins and certain vitamins and minerals. In view of the above, there is urgent need for supplementing the diets of industrial workers with low cost protective foods for making up the deficiencies in their diets.

Effect of dietary improvement on working efficiency

Studies carried out in Western Countries have shown that improvement of the diets consumed by industrial workers brings about a significant increase in the rate of production. The following experiments carried out in Germany are of interest and demonstrate the beneficial effects of supplementary feeding on work output.

(*i*) The influence of dietary supplements on the work output of a group of coal miners in the Ruhr District was investigated with the aim of finding whether the low production could be raised by increasing the food rations. A first supplement of 400 calories increased the coal output to almost 10 tons per person, which was what the workers knew was expected of them. The resulting fall in body weight indicated that energy expenditure was slightly in excess of calorie intake. A further increase in calories resulted in a small further increase in output, but body weights rose again. Evidently, 177 calories were required per ton of coal, and for the desired increase in output, 600 extra calories were necessary.

(*ii*) A controlled group of 30 workers engaged in building railway tracks moved about $1\frac{1}{2}$ tons of earth per hour on a food ration supplying a total of 2300 calories. After ten weeks, additional food was given which brought the calories upto 3000 and raised the output to $2\frac{1}{2}$ tons per hour. Output per 1000 calories increased almost 30 per cent. In the course of a year, the work output rose and fell with the inevitable minor fluctuation of food rations, while body weights remained constant or even increased slightly.

A survey carried out by the United States Department of Agriculture in 1955 and 1956 showed that about half of the manufacturing plants in U.S.A. employing 250 or more workers had facilities for serving hot food to the employees and all plants had some arrangements for dispensing snacks and beverages to workers. The results showed that the food services improved the employee

morale, labour-management relations, employee's health, and productivity to a significant extent.

Measures to improve nutrition of workers

The following measures will help to improve considerably the health and well being of workers and their families.

Non-profit food stores

Non-profit food stores offer the chance to promote the consumption of protective foods and staple foods so as to correct deficiencies in the customary diets. Cereals and millets, pulses and supplementary foods like the Indian Multipurpose food and milk can be sold at controlled or subsidised rates.

Canteens: One of the most effective measures for improving the worker's diet is the establishment of canteens for serving nutritious lunch and snacks at cost price or subsidised rates. This is necessary for providing lunch, snacks and dinner for the day and night shift workers. The provision of free or low-cost meals is beneficial to the employees as well as to the industry as it increases the work output and improves the health of the workers. Experiences gained in several countries, particularly in the U.S.A., U.S.S.R., Canada, Australia and several European countries have shown clearly that canteens can play a vital role in providing nutritious meals and snacks to workers and improving their health and working efficiency.

Low-cost nutritious lunches and snacks for workers

Investigations carried out at the Central Food Technological Research Institute, Mysore have shown that low cost nutritious lunches and snacks can be prepared using Indian multipurpose food at about 10 per cent level in various common food preparations. Booklets containing such recipes could be obtained from the Institute.

XXVI. MALNUTRITION AND UNDERNUTRITION

Since the diets consumed by a large majority of the low income groups of the population in India are inadequate both in quality and quantity, malnutrition and undernutrition are widely prevalent among the vulnerable sections of the people.

MALNUTRITION

The term malnutrition refers to the effects of partial deficiency of one or more nutrients in the diet. The effects of deficiencies of the different nutrients are described under each nutrient. Since the diets consumed by a large majority of the population in India are partially lacking in proteins, calcium and certain vitamins, protein malnutrition and symptoms of vitamin deficiencies and anaemias due to deficiency of iron and folic acid are widely prevalent among weaned infants, young children and expectant and nursing mothers. The signs and symptoms of malnutrition are given in Table 66.

UNDERNUTRITION

The term refers to the effects of inadequate food intake. In undernutrition, the signs and symptoms of deficiencies of almost all nutrients may be present in varying degrees. The signs and symptoms of undernutrition in various age groups are described below:

Infants and weaned infants

Inadequate food intake over long periods leads to a condition known as *marasmus*. The clinical picture is that of an emaciated infant which is grossly underweight. Subcutaneous fat is practically absent and wasting of muscles usually present. The skin is rough

and dry. Signs and symptoms of vitamin deficiencies and anaemia are usually present.

Children

The children are stunted and very much underweight. The skin is dry and subcutaneous fat is practically absent. Other signs and symptoms of malnutrition described in Table 66 may be present in varying degrees depending on the deficiencies in the diet. Undernourished children are weak, mentally backward and show no interest in their work.

Adults

In the well developed adult, prolonged undernutrition will cause loss in weight and loss of subcutaneous fat. The person will be weak and unable to do physical work. Signs and symptoms of deficiencies of vitamins and anaemia are frequently present.

Table 66. **Signs and symptoms of malnutrition**

Clinical findings	Suggested deficiency
General	
Underweight	Calories, proteins, calcium, phosphorus, vitamins
Underheight	
Pallor	Iron, folic acid, vitamin B_{12}, ascorbic acid, thiamine, vitamin B_6
Hair	
Dry, staring hair, usually with pediculi	General malnutrition
Skin	
Follicular keratosis	Vitamin A; unknown
Dermatitis of pellagra	Niacin
Seborrhea, especially in nasolabial folds, external canthi, behind ears and body folds	Riboflavin; unknown
Hemorrhagic manifestation	Ascorbic acid, vitamin K; unknown
Scrotal dermatitis	Riboflavin

Table 66. (*Continued*)

Clinical findings	Suggested deficiency
Eyes	
Bitot's spots	Vitamin A
Corneal vascularity	Unknown; riboflavin
Circumcorneal injection	Unknown; riboflavin
Follicular conjunctivitis	Unknown; allergy
Scarlet conjunctivitis	Niacin
Blepharitis	Unknown; vitamin A, riboflavin,
Night blindness	Vitamin A
Photophobia	Vitamin A, riboflavin
Lips	
Cheilosis	Riboflavin, B-Complex, pyridoxine
Angular stomatitis	Riboflavin, B-complex, iron
Angular fissures	Riboflavin, B-complex
Tongue	
Scarlet red glossitis	Niacin, folic acid, vitamin B_{12}, protein
Beefy red glossitis	Niacin, folic acid, vitamin B_{12}, protein, pyridoxine (?)
Magenta glossitis	Niacin, folic acid, vitamin B_{12},
Chronic glossitis of malnutrition (changes in papillae)	B-complex, protein unknown
Edema of the tongue	Niacin, unknown, protein
Oral mucous membranes	
Scarlet stomatitis	Niacin
Teeth and gums	
Caries	Unknown
Malocclusion	Vitamin D; unknown
Scorbutic gums	Vitamin C
Gingivitis	Vitamin C; unknown
Skeletal	
Rachitic deformities	Vitamin D, calcium, phosphorus
Osteomalacia	Vitamin D, calcium, phosphorus

Table 66. (*Continued*)

Clinical findings	Suggested deficiency
Nervous	
Nutritional polyneuropathy	Thiamine, B-Complex
Circulatory	
Beriberi heart disease	Thiamine
Edema	Protein, thiamine, starvation
Endocrine	
Simple goitre	Iodine

XXVII. OBESITY

Obesity is a condition in which there is excessive deposition of body fat as a result of overeating. Food consumed in excess of body requirements is converted into fat and deposited in the adipose tissue under the skin. This fat normally serves as a source of energy during conditions of starvation or semi-starvation. From the mortality statistics of Life Insurance Companies, it has been observed that the longevity of obese persons is definitely less than that of normal individuals.

Causes of obesity

The important causes of obesity are (1) overeating (2) lack of physical exercise and (3) changes in hormonal activities. It has been estimated that an intake of even 100 calories per day over the daily energy needs can cause an increase of 10 lb. of body weight in an year. The increase in the income of the population has encouraged excessive consumption of foods rich in fat and sugar over and above the energy needs. With the increasing transport facilities, a majority of people do less physical work and consequently their caloric needs become less. These two factors are primarily responsible for the development of obesity in a large majority of adults. Parents encourage their children to overeat as they think the fatter a child is the more healthy it is. Children also tend to follow the parents in eating habits and when once the overeating habit is established in children, a familial trend to development of obesity is commonly observed.

Ill-effects of obesity

The obese person becomes more prone to diseases like high blood pressure, and diabetes than normal persons. This has been borne out by surveys carried

out in many countries. Obesity also decreases the longevity of people. Life Insurance Companies all over the world have therefore prepared a height-weight table giving a desirable weight for a given height for normal adults. A height-weight relationship for normal adults over 25 years is given in Table 67.

Treatment of obesity

The most common methods of treatment of obesity are by (1) reduced food intake and (2) regulated physical exercise.

Reduced food intake

The aim of reduced food intake is to produce a calorie 'deficit' which will result in the fat stored in the adipose tissue being used to meet the calorie needs. It has been observed that consumption of a diet providing about 1000 calories (about half the daily calorie requirement) and sufficient amounts of proteins, vitamins and minerals to meet the daily needs, will help to reduce body weight by about 2 to 3 lb. a week. Consumption of a diet providing 1300 calories may help to reduce about to 1-2 lb. a week. The composition of reducing diets providing about 1000 and 1300 calories and of diets for maintaining body weight at a fairly constant level after weight reduction are given in Table 68. When the body weight returns to normal (as indicated in Table 67), the subject can change to the weight maintenance diet supplying about 1600 or 2000 calories depending on the calorie requirements which will help to keep the body weight fairly constant. It is essential that the subject should weigh himself once a week so as to make sure that the weight is being maintained at a constant level.

Exercise

Most obese persons lead a sedentary life. Sustained mild to moderate exercise will help to prevent obesity in a subject who is consuming a diet just meeting the

calorie requirements. Walking is a good moderate exercise. Walking, 3 miles a day will require about 300 calories which will represent approximately the calorie value of slightly more than one ounce of fat. This may appear to be a small amount but one ounce of fat taken daily over and above the calorie requirements could bring about an increase in body weight of about 20 lbs. in a year.

Prevention

Development of obesity can be prevented by avoiding excessive and frequent eating of foods rich in calories viz., fried foods, sweet etc., and by taking mild to moderate exercises daily. Education in nutrition and dietetics to mothers and school children will help effectively in preventing over-feeding of family members.

Table 67. **Height-weight table giving a desirable weight for a given height for normal adults**

Men				
Height (with shoes on)		Weight in pounds, as ordinarily dressed, including shoes and suit		
Feet	Inches	Small frame	Medium frame	Large frame
5	2	116-125	124-133	131-142
5	3	119-128	127-136	133-144
5	4	122-132	130-140	137-149
5	5	126-136	134-144	141-153
5	6	129-139	137-147	145-157
5	7	133-143	141-151	149-162
5	8	136-147	145-156	153-166
5	9	140-151	149-160	157-170
5	10	144-155	153-164	161-175
5	11	148-159	157-168	165-180
6	0	152-164	161-173	169-185
6	1	157-169	166-178	174-190
6	2	163-175	171-184	179-196
6	3	168-180	176-189	184-202

Women

Height (with shoes on: 2 inch heels)		Weight in pounds, as ordinarily dressed including, shoes and dress		
Feet	Inches	Small frame	Medium frame	Large frame
4	11	104-111	110-118	118-127
5	0	105-113	112-120	119-129
5	1	107-115	114-122	121-131
5	2	110-118	117-125	124-135
5	3	113-121	120-128	127-138
5	4	116-125	124-132	131-142
5	5	119-128	127-135	133-145
5	6	123-132	130-140	138-150
5	7	126-136	134-144	142-154
5	8	129-139	137-147	145-158
5	9	133-143	141-151	142-162
5	10	136-147	145-155	152-166
5	11	139-150	148-158	155-169

Table 67 details average normal weight for men and women over 25, graded according to body frame. The Table allows about 8 pounds for men's clothing and 4 pounds for women's. Age is not specified; the values are for persons 25 to 30 years age, and the premise is that no further weight change with age is desirable. The normal weight of girls 18 to 25 may be arrived at by subtracting about one pound for each year under 25. The table recognises the fact that, within the same height class, body weights must differ in accordance with relative skeletal breadth; unfortunately there is no accepted system for evaluating into which frame classification a particular individual belongs.

Table 68. **Reducing diets and weight maintenance diets for adults** (Ounces/day/adult)

Foodstuffs	Reducing diets				Weight maintenance diets[2]			
	Diet I (1000 calories)		Diet II (1300 calories)		(1600 calories)		(2000 calories)	
	V	NV	V	NV	V	NV	V	NV
Cereals (rice, wheat and millets)	3	3	4	4	5	5	9	9
Pulses[1]	1	1	2	2	2	2	2	2
Skim milk powder[1]	3	1	3	1	3	1	3	1
Milk, cow's	5	5	10	10	10	10	10	10
Eggs	...	1	...	1	...	1	...	1
Meat and fish	...	4	...	4	...	4	...	4
Green leafy vegetables	4	4	4	4	4	4	4	4
Roots and tubers	3	3	3	3	3	3	3	3
Other vegetables	8	8	6	6	4	4	4	4
Fruit	3	3	3	3	3	3	3	3
Oils and fats	0.25	0.25	0.25	0.25	0.5	0.5	0.5	0.5
Cane sugar	0.5	0.5	0.5	0.5	1.0	1.0	1.0	1.0

[1] 2 ounces of Indian multipurpose food (available from Chandra Corporation, Coimbatore) can be used in place of 1 ounce of pulses and 1 ounce of skim milk powder. It is desirable to take daily a multi-vitamin-mineral tablet providing about half the daily requirements.

[2] Diets which can be used for maintaining body weight constant after weight reduction is achieved.

XXVIII. GERIATRIC NUTRITION

Geriatric nutrition deals with the nutritional requirements of old people. The process of ageing brings about physiological, psychological and immunological changes which influence the nutritional requirements.

Physiological changes

Certain changes in the alimentary canal and its ancillary structures take place as age advances. Loss of teeth interferes with proper mastication; inability to chew the food may reduce the tolerance to certain types of food due to incomplete digestion and hence such foods are usually avoided by old people. Because of teeth defects or loss of teeth, old persons frequently choose only the softer foods which may lead to constipation. The secretion of digestive enzymes by the stomach pancreas and intestines, usually diminishes with advancing age. Gastric acidity also is reduced markedly. Therefore ability to digest foods diminishes. Changes in the intestinal mucosa may impede absorption of nutrients. Because of the interference in digestion and absorption certain dietary deficiencies are likely to occur. Transportation of food nutrients from the intestinal tract to the different tissues is often adversely affected by the changes in the circulation and reduce oxygen uptake. The gradual diminution of renal efficiency may necessitate a decrease in the load of solutes e.g., sodium chloride, urea etc., excreted in the urine. The basal metabolism decreases with advancing age and the total energy requirements also decrease with diminishing physical activity. Hence the energy requirements per unit body weight decrease with advancing age. Because of the changes in the glucose tolerance test, the aged person does not tolerate a low blood sugar level. There are also changes in the ability to adjust to changes in fluid intake.

Psychological changes

As a result of psychological changes, there are also changes in the likes and dislikes for different foods. Prejudices against some foods also develop with advancing age. All these factors have to be given due consideration in planning balanced diets for the aged people.

Specific nutritional needs

The basic nutritional requirements of the aged people are similar to those of normal adults with suitable adjustments for reduced calorie requirements and are given in Table 69.

Calories

As a result of reduced basal metabolic rate and physical activity the calorie requirements are about 25 per cent less than those of normal adults doing light work. The calorie intake should be adjusted to keep the body weight constant in the case of normal old people.

Proteins

In view of the tendency to eat less as a result of loss of appetite and poor digestive capacity, old people are likely to suffer from protein deficiency. In view of this, adequate intake of protein should be ensured by the consumption of adequate amounts of protein-rich foods. It may be particularly difficult for vegetarians to maintain adequate protein intake. This may be achieved by including about one ounce of protein-rich foods like Indian multipurpose food or skim milk powder in the daily diet (Table 70).

Fat

The fat intake should be kept at the minimum and should preferably not exceed 50 g. daily. At least half this quantity should be in the form of vegetable oils

rich in essential fatty acids (Table 70). Loss of calcium from the bone leads to the condition called *osteoporosis* in which the bone becomes more fragile. This is responsible for the frequent incidence of fractures in old people.

Minerals

Calcium and iron deficiencies occur frequently as the absorption of these elements is less efficient than in normal adults. The calcium intake should be at least 0.8 g. daily. Since anaemia of even a mild degree affects the health of the old people due to less efficient circulation, iron intake should be adequate to prevent anaemia.

Vitamins

Mild deficiencies of several vitamins occur frequently in old people. It is therefore essential to ensure adequate intakes of all essential vitamins. If the diet consumed does not provide adequate amounts of all vitamins a multivitamin tablet providing half the daily requirements of different vitamins may be taken daily. Inclusion of 400 I.U. of vitamin D daily will help to increase the absorption of calcium and prevent *osteoporosis*.

Water

The importance of an adequate fluid intake to maintain the volume of urine passed daily at a minimum of 1.5 litres is not generally recognised. This is particularly important during summer months. Water can be consumed in the form of buttermilk, fruit juices, soups, porridge etc.

Bulk

Adequate intake of soft unavailable carbohydrates in the form of tender vegetables and fruits should be

ensured to avoid constipation. The senile intestinal mucosa does not tolerate roughage from bran and mature vegetables.

Conclusion

The essentials of good geriatric nutrition should take into consideration the following basic principles and factors (1) attention to individual variations in dietary requirements and likes and dislikes for foods (2) ability of the individual to digest different categories of foods (3) adequate water intake for maintaining a normal urine volume (4) inclusion of soft unavailable carbohydrates to avoid constipation (5) calorie intake adjusted to keep the body weight constant in the case of normal old people (6) calcium and iron intakes adequate to maintain positive balance and to prevent *osteoporosis* and anaemia respectively (7) protein intake to maintain a slight positive nitrogen balance (8) adequate vitamin intake to prevent the occurrence of mild vitamin deficiency symptoms (9) variety in the diet taking into account the palatability and digestibility of the foods to suit the appetite of the individuals and (10) mild physical activity, recreation and entertainment to avoid worries and monotony and to help maintaining normal health.

Table 69. **Nutritional requirements of old people over 60 years**

Nutrients	Man	Woman
Calories	2000	1700
Protein (g)	70	60
Calcium (g)	0.8	0.8
Iron (mg)	20	20
Vitamin A (I.U.)	5000	5000
Thiamine (mg)	1.2	1.0
Riboflavin (mg)	1.4	1.2
Nicotinic acid (mg)	12	10
Vitamin C (mg)	50	50
Vitamin D (I.U.)	400	400

Table 70. **Balanced diets for old people over 60 years**

Foodstuffs	Man		Woman	
	V	NV	V	NV
Cereals	10	10	7	7
Pulses[1]	3	2	3	2
Milk and curds[2, 3]	20	5	20	5
Meat and fish	..	2	..	2
Egg	..	1	..	1
Green leafy vegetables	3	3	3	3
Roots and tubers	2	2	2	2
Other vegetables	2	2	2	2
Fruits	2	2	2	2
Vegetable oils	1	1	1	1
Sugar and jaggery	1	1	1	1

[1] If pulses cause digestive trouble, other protein foods such as Indian multipurpose food and calcium caseinate can be consumed to provide about 20g. protein.

[2] Part of the milk and curd can be consumed as skim milk.

[3] It will be desirable to take daily a multivitamin preparation providing about half the daily requirements of vitamins and minerals.

XXIX. PREVENTION OF MALNUTRITION IN INDIA

Diet surveys carried out in different parts of India have revealed that the diets consumed by a large majority of the population are lacking in protective and protein rich foods, such as milk, eggs, meat and fish. The diets consumed by the low income groups are deficient in proteins, calcium, iron, vitamin A, riboflavin, folic acid and vitamin B_{12}. Protein malnutrition and vitamin deficiency diseases are widely prevalent among weaned infants and pre-school children. A large percentage of expectant and nursing mothers suffer from anaemias and malnutrition. In view of the shortage in the production of milk, eggs, meat and fish, the deficiencies in the diets will have to be made up by the inclusion of locally available low cost foods of vegetable origin. Investigations carried out at the Central Food Technological Research Institute, Mysore, have shown that processed protein foods based on oilseed meals and legumes can be used as effective supplements to the diets of weaned infants, and pre-school children, school children and expectant and nursing mothers. Milk substitutes prepared in the home from groundnut or soyabean can be used as a supplement to mother's milk in the feeding of infants when the parents cannot afford to buy cow's or buffalo's milk. It should be the duty of the parents and the Government to make sure that all the available supplies of milk be used for feeding infants.

Increased production of cereals, pulses and oil seeds

The diets consumed in India are deficient in both quantity and quality. There is a shortage in calorie and protein intakes to the extent of 30 per cent and of vitamin A and riboflavin and calcium to the extent of 30 to 50 per cent. Hence, there is urgent need for

increasing production of cereals and pulses to the extent of 50 per cent as these are consumed as staple foods by the low income groups of the population.

Increased production of protective foods

There is urgent need to increase the production of protective foods such as milk, eggs and oilseeds such as groundnut, legumes and green leafy vegetables and also for the production of processed protein foods fortified with essential vitamins and minerals based on oilseed meals and legumes.

Increased production of protective foods through Applied Nutrition Programme

By adopting modern methods of agriculture and animal husbandry, attempts are being made throughout the country in the community project areas, to increase the production of cereals, oilseeds, legumes, milk and eggs. Attempts are also being made to increase the production of green leafy vegetables and cheap fruits through kitchen gardens. The extra foods produced could be used for feeding the vulnerable sections of the population.

Production of processed protein foods and milk substitutes based on oilseeds and legumes

Milk substitutes based on soyabean have been used in many South East Asian Countries for the feeding of infants. Milk substitutes from soyabean and groundnut could be prepared both on commercial and home scales (Chapter XV) and used for feeding infants and pre-school children along with available cow's or buffalo's milk. Recent investigations carried out at the Central Food Technological Research Institute, Mysore have shown that processed protein foods based on oilseeds and legumes such as Indian multipurpose food and Balanced malt food (Chapter XV) could be used for feeding weaned infants. These foods can be manufactured in large quantities in different states and distributed through

schools and Maternity and Child Health Centres for supplementing the diets of school children, pre-school children and expectant and nursing mothers. The supplementary foods required for making up the deficiencies in the vulnerable sections of the population are given in Table 71.

Measures for improving the health of the community

The following measures adopted on a country wide scale will help to improve the nutrition and health of the people as a fair percentage of the population cannot afford to buy extra foods listed in Table 71.

Maternity and Child Welfare Centres

Supplementary foods for (*i*) Infants, (*ii*) Weaned infants and pre-school children and (*iii*) Expectant and nursing mothers should be distributed free of cost through maternity and child welfare centres to the low-income groups of the population.

School lunch programme

Food supplements listed in Table 71 should be distributed by the Government to schools for use in school feeding programmes. Children belonging to poor classes should be given free lunch.

Out-patient departments of Women's and Children's Hospitals

Malnourished expectant and nursing mothers and children attending out-patients' departments of hospitals should be given supplements of a protein food such as Indian multipurpose food and iron tablets for anaemia.

Table 71. **Supplementary foods for different age groups of the low income groups of the population**

Sl. No.	Age group	Supplementary foods to customary diet
1.	Infants	Fresh cow or buffalo milk (16-20 ounces per day per head). If adequate amounts of cow or buffalo milk are not available, milk substitute prepared from groundnut or soyabean (Chapt. XV) can be mixed with cow's or buffalo milk in equal proportions and used.
2.	Weaned infants and preschool children	Eggs .. Twice a week—one Puffed Bengalgram dhal powder — 1 ounce Balanced Malt Food or Indian multipurpose food (to be given as sweetened porridge) or — 1 ounce Milk substitutes prepared from groundnut or soyabean —10 ounces Tender green leafy vegetables (cooked and mashed) — 1 ounce Cooked and mashed dhal — 1 ounce
3.	School children and adolescents	Puffed Bengalgram or peas — 1 ounce Roasted groundnut kernels — 1 ounce Puffed cereals — 2 ounces Green leafy vegetables — 4 ounces
4.	Expectant and nursing mothers	Pulses — 3 ounces Roasted groundnut kernels — 2 ounces Indian Multipurpose food — 1 ounce Green leafy vegetables — 4 ounces

XXX. THERAPEUTIC DIETS

Diets for patients suffering from various diseases are usually prescribed by the doctors. In this chapter the diets for the following conditions (1) Diabetes mellitus (2) Hypertension (3) Renal calculi and (4) Peptic ulcer are given to help individuals getting treatment at home to adjust their daily diets to their needs. The patient should consult the doctor for the diet suitable for his or her condition.

Diets for diabetes mellitus

In this disease the utilisation of glucose by the body is seriously affected. Consequently the level of glucose in the blood increases and glucose is excreted in urine. In addition to treatment with insulin, the diet has to be controlled. Investigations carried out at the Central Food Technological Research Institute have shown that ingestion of cooked black gram, tender field beans (*Dolichos Lab Lab*) and casein (milk protein) along with the usual diet helps to lower the blood sugar level. For planning a suitable diet, the age, sex and size (height and weight) of the patients have to be considered. If the individual is overweight, the calories will have to be reduced so as to enable him or her to lose weight steadily and attain the weight ideal for his or her age and size. Diets suitable for adult diabetics are given in Table 72.

When planning diets for diabetics the chart for ideal weight for age should be consulted and the diet adjusted according to calorie and protein requirements. For example, if a patient's ideal weight is 60 kg. he needs 60 gms. of protein per day. For maintaining this weight he needs 25 to 30 cals per kg. or $60 \times 30 = 1,800$ cals per day. For reducing weight, he needs 15-20 cals per kg. or $60 \times 20 = 1200$ cals per day. These calories could be distributed between the principle meals.

Diets for hypertension

Diets for people suffering from hypertension (high blood pressure) should be low in sodium. If hypertension is associated with atherosclerosis, the diet should be low in sodium and in saturated fats (ghee, butter, coconut oil and hydrogenated fats such as vanaspathi and animal body fats) and foods rich in cholesterol (Table 81). Diets low in sodium and fat are given in Table 73.

Renal Calculi (stones)

Renal calculi may be broadly divided into three groups (1) Oxalate stones (2) Urate stones and (3) Phosphate-carbonate stones. It is essential to avoid foods rich in purines and oxalates and consume large amounts of foods giving an alkaline ash. The patients should consume large amounts of water. Data regarding the oxalic acid and purine contents of foods are given in Tables 79 and 80. Model diets suitable for subjects with a tendency to the formation of stones are given in Table 74.

Peptic Ulcer

Peptic ulcer is one of the most common diseases occurring in adults. The ulcers are present in the stomach in gastric ulcer and in the duodenum in duodenal ulcer. Severe cases require hospitalisation and treatment by a doctor. Mild cases require careful dieting in addition to medication as advised by doctors. The diets given in Table 75 are suitable for mild cases of gastric and duodenal ulcers treated at home and not requiring hospitalisation.

Table 72. **Diets for adult diabetic patients (ounces/day/adult)**

Foodstuffs	1500 cal.		1600 cal.		1800 cal.		2000 cal.	
	V	NV	V	NV	V	NV	V	NV
Cereals (rice, wheat and millets)	3	3	4	4	6	6	6	6
Pulses (blackgram dhal, Bengalgram, Field beans etc.)	5	2	5	2	5	2	5	2
Nuts (groundnut, cashew-nut etc.)	1	1	1	1	1	1	1	1
Skim milk powder*	2	1	2	1	2	1	2	1
Milk (cow's or buffalo)	8	8	8	8	8	8	8	8
Eggs	...	1	...	1	...	1	...	1
Meat and fish	...	4	...	4	...	4	...	4
Vegetables, green leafy	6	6	6	6	6	6	6	6
,, other vegetables	6	6	6	6	6	6	6	6
Vegetable oils	1.0	1.0	1.0	1.0	1.0	1.0	1.5	1.5
Butter or ghee	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5

* Casein preparation *one ounce* can be used in place of *two ounces* of skim milk powder.

If skim milk powder is not available, liquid skim milk obtained from a local dairy can be used (1 ounce of skim milk powder is approximately equal to 10 ounces of liquid skim milk).

Table 73. **Diets low in fat and sodium for adults suffering from hypertension associated with Atherosclerosis**

Foodstuffs	1800 cal.		2000 cal.		2200 cal.	
	V	NV	V	NV	V	NV
Cereals (including bread)	5	5	7	7	9	9
Pulses	4	2	4	2	4	2
Skim milk powder*	2	1	2	1	2	1
Milk, cow's or buffalo (toned)	6	6	6	6	6	6
Eggs	...	1	...	1	...	1
Meat and Fish	...	2	...	2	...	2
Vegetables, green leafy	4	4	4	4	4	4
,, roots and tubers	4	4	4	4	4	4
,, other vegetables	4	4	4	4	4	4
Fruits	8	8	8	8	8	8
Vegetable oil rich in unsaturated fatty acids (sesame oil or safflowerseed oil)	1	1	1	1	1	1
Sugar	2	2	2	2	2	2
Sodium content of diets (mg)	(200–300)	(300–400)	(300–400)	(400–500)	(400–500)	(500–600)

* If skim milk powder is not available, liquid skim milk obtained from a local dairy can be used (one ounce of skim milk powder is approximately equal to 10 ounces of liquid skim milk).

Table 74. **Diets for subjects predisposed to renal calculi**

	2000 cal.		2400 cal.		2800 cal.		3200 cal.	
	V	NV	V	NV	V	NV	V	NV
Whole cereals	4	4	5	5	6	6	7	7
Milled cereals (milled rice and white flour)	3	3	5	5	7	7	9	9
Pulses	3	2	3	2	3	2	3	2
Groundnut or Cashewnut	2	1	2	1	2	1	2	1
Milk	16	6	16	6	16	6	16	6
Eggs	...	1	...	1	...	1	...	1
Meat and fish	...	2	...	2	...	2	...	2
Vegetables, green leafy (low in oxalic acid)	4	4	4	4	4	4	4	4
,, non leafy (low in oxalic acid)	4	4	4	4	4	4	4	4
,, roots and tubers (low in oxalic acid)	8	8	8	8	8	8	8	8
Fruits	6	6	6	6	6	6	6	6
Oils and fats	2	2	2.5	2.5	3.0	3.0	3.5	3.5
Sugar and jaggery	2	2	2	2	2.5	2.5	3.0	3.0

Table 75. **Diets* for mild cases of peptic ulcer (ounces/adult/day)**

	2200 cal.		2400 cal.		2600 cal.		2800 cal.	
	V	NV	V	NV	V	NV	V	NV
Cereals, milled (white flour or raw milled rice including bread and biscuits)	6	6	8	8	10	10	12	12
Pulses, dehusked	2	2	2	2	2	2	2	2
Milk, Cow's or Buffalo	32	24	32	24	32	24	32	24
Eggs	...	1	...	1	...	1	...	1
Meat and fish	...	2	...	2	...	2	...	2
Cheese	2	2	2	2	2	2	2	2
Leafy vegetables, tender	2	2	2	2	2	2	2	2
Other vegetables, tender	2	2	2	2	2	2	2	2
Potatoes	6	6	6	6	6	6	6	6
Fruit juice (non-acid) (tomato, mango and orange)	4	4	4	4	4	4	4	4
Oils and fats	1	1	1	1	1	1	1	1
Butter	1	1	1	1	1	1	1	1
Sugar	2	2	2.5	2.5	3.0	3.0	3.0	3.0

* All spices should be completely avoided. Foods and drinks not allowed include (1) whole cereals containing bran (2) All spices and condiments (3) Fruits and vegetables containing fibre (4) Strong coffee, tea (5) Alcoholic drinks (6) Fried foods.

XXXI. SODIUM CONTENT OF FOODS AND THE PLANNING OF LOW SODIUM DIETS

Introduction

The popularity of low sodium diets or sodium restricted diets has increased greatly in recent years because of the increased knowledge of the sodium content of foods and the therapeutic usefulness of sodium restriction in congestive heart failure, cirrhosis of the liver, hypertensive disease, certain diseases of the kidneys and the toxaemias of pregnancy.

In referring to the low sodium diet, the term 'salt free' is often used. There is some sodium in practically every food that we eat inasmuch as, sodium is a very common ingredient in the plant and animal food products. Persons on a low sodium formula are generally asked not to use extra salt and so the term 'salt free' has come into use. When the emphasis is rightly placed upon the avoidance of extra salt, there is a strong tendency to forget that many natural foods are rich sources of sodium and care is necessary in selecting a diet having a low sodium content.

Sodium exists in food only in combination with other elements like chlorine, phosphorus etc. In common salt for example, sodium is combined with chlorine. Normally the quantity of sodium excreted daily equals the quantity of sodium ingested so that a state of sodium balance prevails. Sodium is ingested as it occurs in food or as common salt added to foods during cooking for increasing their palatability. In this way, the sodium intake is partly determined by taste, custom and climatic conditions. The sodium ingested is rapidly absorbed from the gastrointestinal tract, distributed throughout the extra cellular fluid and finally excreted in urine by the kidney.

Functions of Sodium

The sodium in the extra cellular fluid participates in maintaining osmotic equilibrium between the extracellular fluid and the tissue cells. It also contributes the sodium ion which in conjunction with bicarbonate and phosphate ions helps to maintain the pH of blood within normal limits. Other functions of sodium, alone or in relation to other cellular ions are concerned in the conduction of nervous impulses, muscle contractility and especially the control of heart muscle conduction and contractility. Sodium is intimately associated with the disposition of water since normally water is retained or excreted with this cation in quantities to maintain the tonicity of body fluids although the specific mechanisms involved in the regulation of the excretion of sodium and water are not identical.

Sources of Sodium; Sodium content of foods

Data on the sodium content of foods have been published from several countries. Recently, some fairly extensive studies on the sodium content of Indian foods have become available. In order to bring the available data together for more convenient reference, sodium values for various foods are given in Table 76. Figures for potassium content are also given.

Table 76. **Sodium and Potassium Contents of Foodstuffs**

Name of Foodstuff	*Botanical Name*	*Values per 100g*	
Cereals		*Sodium*	*Potassium*
		mg.	*mg.*
Bajra (cambu)	Pennisetum Typhoideum	10	402
Barley	Hordeum vulgare	4	179
Cholam	Sorghum vulgare	7	321
Maize or corn	Zea mays	6	290
Rice raw (home pounded)	Oryza sativa	10	116
Rice raw (polished)		4	110
Rice (parboiled, milled)		9	161

Table 76 (Continued)

Cereals	*Botanical Name*	*Sodium mg.*	*Potassium mg.*
Wheat	Triticum vulgare	18	349
Wheat flour		14	101
Pulses			
Bengalgram (with husk)	Cicer arietinum	71	322
Bengalgram (without husk)		72	386
Blackgram (with husk)	Phaseolus mungo	80	523
Blackgram (without husk)		75	643
Cow gram	Vigna catiang	95	323
Field bean	Dolichos lablab	89	402
Green gram (with husk)	Phaseolus radiatus	57	583
Green gram (without husk)		49	643
Horse gram	Dolichos biflorus	46	322
Lentil (Masur dhal)	Lens esculenta	29	402
Lentil (without husk)		23	482
Peas (dried)	Pisum sativa	20	980
Red gram (with husk)	Cajanus cajan	63	435
Red gram (without husk)		66	482
Leafy vegetables			
Brussels sprouts	Brassica oleracea gemifera	12	400
Cabbage	Brassica oleracea capitala	7	277
Celery	Apium gravedens rapaceum	91	293
Coriander leaves	Coriandrum sativum	4	453
Lettuce	Pisonia alba	9	329
Spinach	Spinacia oleracea	89	570
Roots and Tubers			
Beet root	Beta vulgaris	60	300
Carrot	Daucus carota	47	482
Colocasia	Colocasia antiquorum	25	464
Onion	Allium cepa	5	385
Potato	Solanum tuberosum	18	249
Radish	Raphanus sativus	41	325
Sweet Potato	Ipomoea batatas	10	373
Tapioca	Manihot utilissima	2	10
Yam	Typhonium trilabatum	22	422
Other vegetables			
Ash gourd	Benincasa cerifera	2	211
Bitter gourd	Momordica charantia	14	382

Table 76 (Continued)

Other vegetables	*Botanical Name*	*Sodium mg.*	*Potassium mg.*
Brinjal	Solanum melongena	3	229
Cucumber	Lagenaria vulgaris	7	149
Cauliflower	Brassica oleracea botrytes	12	285
Drum stick	Moringa oleifera	6	463
French beans	Phaseolus vulgaris	10	282
Knol Khol	Brassica oleracea caulorapa	12	199
Ladies fingers	Hibiscus esculentus	54	332
Nellikai (Amla)	Phyllanthus emblica	3	201
Peas, green	Pisum sativum	2	346
Plantain, green	Musa paradisiaca	3	365
Pumpkin	Cucurbita maxinia	2	259
Tomato	Lycopersicum esculentum	3	360
Turnip	Brassica rapa	6	243
Vegetable marrow	Cucurbita pepo	5	220
Fruits			
Apple	Pyrus malavs	3	94
Banana	Musa sapientum	2	141
Custard apple	Anona Sqaniosa	2	140
Dates	Phoenix dactylifera	13	537
Figs (Fresh)	Ficus carica	2	190
Grapes	Vitis vinifera	4	249
Grape fruit	Citrus gradisvar maximan	1	200
Guava	Psidium guyava	15	106
Lemons	Citrus medica var timonum	1	148
Peaches	Amygdalis persica	1	212
Pears	Pyrus communis	2	161
Pine apple	Ananas sativus	1	86
Plums	Prunus domestica	1	198
Pomegranate	Punica granatum	4	171
Papaya, ripe	Carica papaya	5	211
Raspberries		1	224
Raisin, dry	Vitis vinifera	67	629
Strawberries	Fragaria grandiflora	1	161
Water melon	Citrullus vulgaris	1	115
Nuts and oil seeds			
Cashew nut (unsalted)	Anacardium accidentale	41	129
Groundnut, roasted (unsalted)	Arachis hypogea	4	700
Cocoanut, raw	Cocoa nucifera	15	336
Cocoanut, dry		30	700

Table 76 (Continued)

Dairy Products	*Sodium mg.*	*Potassium mg.*
Milk, fresh-whole	34	130
Milk, fresh (skimmed)	32	116
Milk (condensed)	140	340
„ (malted dry)	440	720
Butter milk	57	193
Skim milk powder	450	1210
Whole milk powder	410	1100
Butter (unsalted)	4	5
Egg whole	129	145
„ white only	184	154
„ yolk only	57	129
Flesh Foods		
Fish (Rohi)	69	225
Mutton (Goat's meat)	63	244
Chicken	58	322
Liver	83	296
Lamb	90	327
Pork	55	260
Beef	65	333
Miscellaneous		
Bread (white, unsalted)	28	120
Dried yeast	3	670
Sago	2	4

Effect of Cooking

All the sodium values of Table 76 refer to raw foods. Little information exists on the changes in the sodium content of foods during cooking and the subject requires more study. Many vegetables are cooked by boiling in water and the excess water is discarded and it is found that some of the sodium present in the vegetables is lost in the rejected water.

Sodium content of waters

The sodium content of drinking and cooking water must be taken into account when diets of various levels of sodium restriction are formulated. Water from different places show different values for sodium content.

The sodium content of drinking water may vary widely from 10-30 mg. per litre.

Incidental sources of Sodium

Persons on a sodium restricted diet should take into account the sodium content of sodium bearing medicinals. They should certainly avoid the use of 'Antacids' or 'alkalising' preparations containing sodium bicarbonate and frequently used for treating digestive troubles and in mixtures. The physician should also bear in mind that certain medicinals e.g., sodium salicylate may contain enough sodium to disorganise a sodium restricted regimen.

Salt substitutes

Salting is an accepted means of improving the palatability of fresh and prepared foods. Restriction of sodium may alter the palatability and make it difficult for patients to adhere to a prescribed regimen. For this reason various 'salt substitutes' have been prepared. Most of these are mineral-base salt substitutes consisting of salts of ions other than sodium, compounded to simulate sodium chloride in taste. Potassium and ammonium chloride are the salts most commonly used but may contain other materials in addition.

In addition to the above a number of so called vegetized salts are also marketed. These may contain considerable amount of sodium and are probably of doubtful value in a rigidly restricted regimen.

Under normal conditions salt substitutes may be used; in moderation, but after a period of adjustments to dietary sodium restriction many patients adhere to the prescribed diet without recourse to salt substitutes.

Other additions in the diet

Generally speaking all the spices contain a small quantity of sodium and in any case since they are used only in very small quantities, there are no contra indications for their use and they help to improve an

otherwise unattractive diet. Coffee or tea may be taken as desired.

Use of sodium restricted diets in disease states

Sodium restricted diets are prescribed in the following disease states and are found to be beneficial.

1. *Congestive heart failure in which it acts* by reducing the oedema.
2. *Hypertension* in which its action is not definitely known.
3. *Renal disease.*
4. *Cirrhosis of the Liver.* In both these conditions (3) and (4) it acts by reducing the oedema and preventing the accumulation of fluid in the abdomen.
5. Toxaemias of pregnancy to prevent fluid retention.
6. Menier's disease where its action is not quite certain.
7. During ACTH and cortisone therapy in various diseases to prevent sodium retention.

Nutritional implications of sodium restriction

In the preparation of diets restricted to less than 500 mg. of sodium daily, alterations from the diet usually considered optimum may be necessary. Thus a reduction in animal protein and the nutrients usually associated with it may be required and certain other foods specially prepared to remove naturally occurring sodium may be added to the diet. These alterations in the usual dietary customs of persons may not sometimes provide optimum nutrition, a matter to be seriously considered by the physicians prescribing a low sodium diet.

Such changes in the diet as the omission of common salt for seasoning, using sweet butter, salt free bread and omitting foods naturally rich in sodium should involve no nutritional difficulties except for any attendant decrease in taste appeal. The same is also true for processed foods packed without added sodium salts.

Limitations in the amount of milk, meat and eggs may sometimes be necessary particularly if the daily

sodium intake is to be 200 mg. or less. This involves a decrease in protein of high biological value and of the concomitant vitamins of the B-complex. The physician prescribing a low sodium diet must weigh carefully the therapeutic benefits to be expected against the consequences of a possible reduction in the intake of essential nutrients. This may be particularly true of persons already malnourished or with conditioning factors such as defects in intermediary metabolism. In such cases supplements of pure protein preparations like calcium caseinate and multi vitamin tablets may help to provide adequate nutrition.

Planning sodium restricted diets

Broadly, there are two classes of low sodium diets depending on the severity of the condition for which it is prescribed. (*i*) Strict low sodium diet 200-300 mg. of sodium daily. (*ii*) Moderately low sodium diet 400-600 mg. of sodium daily.

The essential data necessary for planning a low sodium diet are: (1) degree of sodium restriction prescribed, (2) other dietary alterations desired and (3) the food habits and customs of the patient.

When these are known one can proceed to plan a diet with confidence.

The following typical food chart (Table 77) for different levels of sodium tolerance gives a rough idea as to form individual diets. It also gives the foods to include every day. All foods are prepared without salt, soda or baking powder. Salt substitutes may be used in moderate quantities.

Broadly, a patient on a low sodium diet should avoid all salted and canned vegetables and pickles, salted butter, cheese, salted nuts, canned meat or fish, bacon, ham, sausages and corned beef. Finally in prescribing a low sodium diet it calls for understanding and co-operation on the part of the patient, and intelligence and the will to please on the part of the housewife or cook to make the endeavour a success.

Table 77. **Low Sodium Diets**

No.	Foods included daily for one day	Diet I Sodium content 200-300 mg./day		Diet II Sodium content 400-600mg./day	
		Vegetarian (ozs.)	Non-vegetarian (ozs.)	Vegetarian (ozs.)	Non-vegetarian (ozs.)
1	Bread, (salt free)	4	4	5	5
2	Cereals (Rice or wheat)	8	6	8	6
3	Pulses	2	1	4	1
4	Egg	..	1	..	1
5	Milk (Fresh whole)	10	4	20	14
6	Unsalted lean meat	..	2	..	4
7	Unsalted roasted nuts	2	2	2	2
8	Potato (unsalted)	4	4	4	4
9	Leafy vegetables	3	3	3	3
10	Non-leafy vegetables	2	2	3	3
11	Fruits	8	8	8	8
12	Unsalted butter	½	½	½	½
13	Sugar	2	2	2	2

Table 77. (*contd.*) **Approximate Composition**

Foods included daily (Total for one day)	Diet I		Diet II	
	Vegetarian	Non-vegetarian	Vegetarian	Non-vegetarian
Carbohydrates (g)	420	367	498	380
Protein (g)	70	71	91	89
Fats (g)	54	59	68	74
Calories	2420	2400	2870	2800
Calculated sodium value (mg)	226	258	375	390

XXXII. NUTRITIVE VALUE OF COMMON INDIAN RECIPES

Food is prepared and cooked in different ways for consumption. A large number of recipes have been developed in different parts of India through ages. Some of these are consumed daily by the people. The nutritive value of common Indian food preparations has been worked out and published in a booklet 'Balanced Diets and Nutritive value of common Indian recipes' by the C.F.T.R.I., Mysore. Data regarding the nutritive value per serving of common food preparations are given in Table 86 and the nutritive value of certain ready-to-serve preparations are given in Table 85. Recipes suitable for feeding preschool children and expectant and nursing mothers and other age groups can be selected from among these recipes according to their nutritional requirements.

Recipes for low cost balanced diets

In the formulation of low cost balanced diets, particular mention should be made of recipes based on foods of high nutritive value viz. (1) ragi (2) pulses and dhals and (3) green leafy vegetables.

Ragi: Ragi (*Eleucine Coracana*) is a millet cultivated in several states of India. It is a very rich source of calcium, in which rice and other cereals and millets are deficient. Consumption of 100 g. of ragi daily will provide from 0.3 to 0.4 g. calcium. i.e., the same amount of calcium supplied by 300 g. milk. Preparations such as ragi balls or ragi puttu can also be given to weaned infants and preschool children.

Pulses and dhals

Pulses and dhals are rich sources of proteins. The diet of the preschool child should include at least 50 g. of

pulses and dhal and that of expectant and nursing mothers atleast 100 g. of pulses and dhal. Idli, a common south Indian preparation based on rice and black gram dhal is a nutritious food which can be given to weaned infants and preschool children. Porridge prepared from Bengalgram on green gram flour can also be given to weaned infants and preschool children.

Groundnut (Roasted)

Groundnut is a rich source of proteins and fat. Groundnut milk prepared on a home scale can be fed to weaned infants and preschool children. The diets of expectant and nursing mothers should include about 25 g. and 50 g. respectively of roasted groundnut kernels.

Green leafy vegetables

Green leafy vegetables are excellent sources of carotene (Provitamin A), calcium and vitamin C. The daily diet of preschool child should include 25 to 50 g. and that of expectant and nursing mothers 100 g. of green leafy vegetables. Cooked and mashed green leafy vegetables can be given to weaned infants and preschool children.

XXXIII. LATHYRISM AND FLUOROSIS

Lathyrism

Lathyrism is a crippling disease, characterised by paralysis of the leg muscles occurring mostly in adults consuming the pulse "Lathyrus sativus" (Khesari Dhal) in large quantities. The disease occurs widely in Central Provinces, Bhopal, Rewa, Uttar Pradesh and Bihar where Khesari dhal is consumed in large quantities by the poor people.

Signs and symptoms

There are four stages in the development of the disease. The first stage is characterised by weakness of the lower limbs. In the second stage, bending of the knee is more marked and there is certain amount of inversion of foot with a tendency to walk on toes. In the third stage, the symptoms become more severe and the subject can walk only with the help of crutches or sticks. In the fourth stage, the knee becomes completely bent and standing in erect posture and walking become impossible.

Aetiology

Recent investigations have led to the isolation and identification of the toxic factor present in Lathyrus sativus as β-oxalyl-amino alanine. This toxic principle when administered to chicks produces symptoms similar to that of human lathyrism.

Prevention

There are three possible approaches for the prevention of lathyrism in human beings. These are (1) Removal of toxic factors from khesari dhal by soaking in hot

water for 4 to 5 hrs. and rejecting the soak water or by boiling the pulse in water and rejecting the water after boiling. (2) Education of the public in regions where lathyrism is endemic regarding the removal of toxic factor by leaching out in water and the dangers of consuming the pulse as such and (3) Enforcement by law of cultivation of other pulses in place of khesari dhal.

Fluorosis

Workers of the Public Health Department from Andhra State (India) discovered in 1931 the occurrence of the disease—chronic endemic fluorosis in man and farm animals in certain parts of the State. Later it was discovered that this disease is caused by the consumption of drinking water containing large amounts of fluorides. The toxic effects are seen in the teeth and bone.

Dental fluorosis (Mottled Enamel)

In many parts of the world where the drinking water contains excessive amounts of fluorine (3-5 P.P.M.) signs and symptoms of dental fluorosis have been observed. The enamel of the teeth loses its lustre and becomes rough and chalky white patches distributed irregularly over the surface of the teeth, with a secondary infiltration of yellow or brown staining, are observed. The enamel is structurally weak and in severe cases there is marked loss of enamel accompanied by 'pitting' which give the tooth surface a corroded appearance.

Skeletal fluorosis

Chronic fluorosis intoxication through drinking water containing excessive amounts of fluorine (over 10 P.P.M.) or through handling fluoride containing minerals results in pathological changes in bones. There is sclerosis i.e., increased density of the bone of the spine, pelvis and limbs due to hypercalcification. In addition the

ligaments of the spine become calcified, producing a 'poker back'. Such persons are crippled and cannot perform simple daily tasks, such as bending, squatting etc., as the joints are stiff.

Prevention of Toxic Fluorosis

Toxic fluorosis can be prevented only by removing fluorine from the water supplies by treatment with activated carbon or by some other suitable adsorbents.

Table 78. **The nutritive value of**

Name of foodstuff	Moisture %	Protein %	Fat %	Mineral matter %	Fibre %	Carbohydrate %
Cereals:						
1 Bajra or cambu	12.4	11.6	5.0	2.7	1.2	67.1
2 Barley	12.5	11.5	1.3	1.5	3.9	69.3
3 Cholam	11.9	10.4	1.9	1.8	3.2	70.3
4 Maize, dry, yellow	14.9	11.1	3.6	1.5	2.7	66.2
5 Oatmeal	10.7	13.6	7.6	1.8	3.5	62.8
6 Ragi	13.1	7.1	1.3	2.2	3.3	73.0
7 Rice, parboiled, milled	13.5	7.1	0.7	0.8	0.2	77.7
8 Rice, raw, milled[2]	12.2	7.0	0.5	0.7	0.2	79.3
9 Wheat, whole[3]	12.8	11.8	1.5	1.5	1.2	71.2
10 Italian millet	11.2	12.3	4.7	3.2	8.0	60.6
11 Samai	11.5	7.7	4.7	4.8	7.6	63.7
12 Varagu or kodu millet	12.8	8.3	1.4	2.9	9.0	65.6
Pulses:						
13 Bengal gram	9.8	17.1	5.3	2.7	3.9	61.2
14 Bengal gram dhal	11.2	22.5	5.2	2.2	...	58.9
15 Black gram dhal	10.9	24.0	1.4	3.4	...	60.3
16 Cow gram	12.0	24.6	0.7	3.2	3.8	55.7
17 Field bean, dry	9.6	24.9	0.8	3.2	1.4	60.1
18 Green gram dhal	10.4	24.0	1.3	3.6	...	60.7
19 Red gram dhal	12.2	22.3	1.7	3.6	...	60.2
20 Soya bean	8.1	43.2	19.5	4.6	3.7	20.9
Nuts and oilseeds:						
21 Almond	5.2	20.8	58.9	2.9	1.7	10.5
22 Cashew nut	5.9	21.2	46.9	2.4	1.3	22.3
23 Cocoanut	36.3	4.5	41.6	1.0	3.6	13.0
24 Gingelly (sesame) seeds	5.1	18.3	43.3	5.2	2.9	25.2
25 Groundnut	7.9	26.7	40.1	1.9	3.1	20.3
Leafy vegetables:						
26 Amaranth, tender	85.8	4.9	0.5	3.1	...	5.7

[1] For botanical and other Indian names of the foodstuffs and the nutritive value of other foodstuffs, reference may be made to Health Bulletin No. 23 published by the Government of India.

Common foodstuffs[1]

Calcium (Ca)%	Phosphorus (P) %	Iron (Fe) mg. %	Calorific value per 100 g.	Vitamin A value (I.U. per 100 g.)	Vitamin B_1 (mg. per 100 g.)	Nicotinic acid (mg. per 100 g.)	Riboflavin (mg. per 100 g.)	Vitamin C (mg. per 100 g.)
0.05	0.35	8.8	360	85	0.33	2.3	0.14	0
0.03	0.23	3.7	335	110	0.45	4.7	0.12	0
0.03	0.28	6.2	341	136	0.35	1.8	0.16	0
0.01	0.33	2.1	342	560	0.42	1.2	0.14	0
0.05	0.38	3.8	374	...	0.54	1.1	0.12	0
0.33	0.27	5.4	332	70	0.42	1.1	0.12	0
0.01	0.17	3.2	346	0	0.22	2.4	0.05	0
0.01	0.11	2.8	348	0	0.11	1.0	0.03	0
0.05	0.32	5.3	348	108	0.54	5.0	0.12	0
0.03	0.29	5.3	334	54	0.59	1.8	0.12	0
0.02	0.36	7.1	328	...	0.33	1.2	0.11	0
0.04	0.24	5.2	308	...	0.33	1.4	0.12	0
0.19	0.24	9.8	361	120	0.45	2.6	0.21	5.0
0.07	0.31	8.9	372	110	0.46	2.8	0.24	...
0.20	0.37	9.8	350	64	0.45	2.0	0.22	...
0.07	0.49	3.8	327	60	0.50	1.5	0.21	...
0.06	0.45	5.0	347	...	0.52	1.8	0.21	...
0.14	0.28	8.4	350	158	0.46	2.0	0.26	...
0.14	0.26	8.8	345	220	0.45	2.4	0.22	...
0.24	0.69	11.3	432	310	0.73	2.4	0.32	...
0.23	0.49	3.5	655	...	0.44	2.5	0.12	0
0.05	0.45	5.0	596	100	0.63	2.1	0.19	0
0.01	0.24	1.7	444	...	0.05	0.8	0.10	1
1.45	0.57	10.5	564	100	1.01	4.4	0.11	0
0.05	0.39	1.6	546	63	0.90	14.1	0.13	0
0.50	0.10	21.4	47	2,500-11,000	0.03	0.9	0.16	173

[2] The chemical composition of raw home-pounded rice is given in Table 21. [3] The chemical composition of white flour, semolina (suji) and bread is given in Tables 19 and 20.

Table 78. **The nutritive value of**

Name of foodstuff	Moisture %	Protein %	Fat %	Mineral matter %	Fibre %	Carbohydrate %
27 Cabbage	90.2	1.8	0.1	0.6	1.0	6.3
28 Coriander	87.9	3.3	0.6	1.7	...	6.5
29 Drumstick	75.0	6.7	1.7	2.3	0.9	13.4
30 Mint	83.0	4.8	0.6	1.6	2.0	8.0
31 Ipomoea	90.3	2.9	0.4	2.1	...	4.3
32 Radish	87.4	2.2	0.5	2.6	2.2	5.1
33 Spinach	91.7	1.9	0.9	1.5	...	4.0
Roots and tubers:						
34 Carrot	86.0	0.9	0.2	1.1	1.2	10.7
35 Colocasia	73.1	3.0	0.1	1.7	...	22.1
36 Onion, big	86.8	1.2	0.1	0.4	...	11.6
37 Potato	74.7	1.6	0.1	0.6	...	22.9
38 Radish	94.4	0.7	0.1	0.6	...	4.2
39 Sweet potato	68.5	1.2	0.3	1.0	...	31.0
40 Tapioca	59.4	0.7	0.2	1.0	...	38.7
41 Yam, elephant	78.7	1.2	0.1	0.8	0.8	18.4
Other Vegetables:						
42 Ash gourd	96.0	0.4	0.1	0.3	...	3.2
43 Brinjal	91.5	1.3	0.3	0.5	...	6.4
44 Broad beans	82.4	4.5	0.1	1.0	2.0	10.0
45 Cauliflower	89.4	3.5	0.4	1.4	...	5.3
46 Cluster beans	82.5	3.7	0.2	1.4	2.3	9.9
47 French beans	91.4	1.7	0.1	0.5	1.8	4.5
48 Cucumber	96.4	0.4	0.1	0.3	...	2.8
49 Ladies finger	88.0	2.2	0.2	0.7	1.1	7.7
50 Plantain, green	83.2	1.4	0.2	0.5	...	14.7
51 Peas, English	72.1	7.2	0.1	0.8	...	19.8
52 Pumpkin	92.6	1.4	0.1	0.6	...	5.3
53 Snake gourd	94.1	0.5	0.3	0.7	...	4.4

Common foodstuffs (*Continued*)

Calcium (Ca) %	Phosphorus (P) %	Iron (Fe) mg. %	Calorific value per 100 g.	Vitamin A value, (I.U. per 100 g.)	Vitamin B_1 (mg per 100 g.)	Nicotinic acid (mg. per 100 g.)	Riboflavin (mg. per 100 g.)	Vitamin C (mg. per 100 g.)
0.03	0.05	0.8	33	2,000	0.06	0.4	0.12	124
0.14	0.06	10.0	45	10,460-12,600	0.05	0.8	0.13	135
0.44	0.07	7.0	96	11,300	0.06	0.8	0.12	220
0.20	0.08	15.6	57	2,700	0.05	0.4	0.14	85
0.11	0.05	3.9	32	3,300	0.05	0.6	0.12	137
0.12	0.09	4.8	33	6,700	0.05	0.5	0.12	65
0.06	0.04	5.0	32	5,500	0.05	0.5	0.11	48
0.08	0.03	1.5	47	2,000-4,300	0.04	0.4	0.02	3
0.04	0.14	2.1	101	40	0.09	0.4	0.03	...
0.18	0.05	0.7	51	...	0.08	0.4	0.01	11
0.01	0.03	0.7	99	40	0.10	1.2	0.01	17
0.05	0.03	0.4	21	...	0.06	0.4	0.02	15
0.02	0.05	0.8	132	10	0.08	0.7	0.04	24
0.03	0.04	0.9	159	...	0.05	0.3	0.01	...
0.05	0.02	0.6	79	434	0.06	0.7	0.07	...
0.02	0.06	1.3	34	5	0.05	0.8	0.06	23
0.03	0.02	0.5	15	...	0.06	0.4	0.01	5
0.05	0.06	1.6	59	...	0.08	0.8	0.07	12
0.03	0.06	1.3	39	38	0.10	0.9	0.08	66
0.13	0.05	5.8	56	330	0.08	0.5	0.06	49
0.05	0.03	1.7	26	221	0.08	0.3	0.06	14
0.01	0.03	1.5	14	...	0.03	0.2	0.02	7
0.09	0.08	1.5	41	58	0.06	0.6	0.06	16
0.01	0.03	0.6	66	50	0.05	0.3	0.02	24
0.02	0.08	1.5	109	139	0.25	0.8	0.01	9
0.01	0.03	0.7	28	84	0.06	0.5	0.04	2
0.05	0.02	1.3	22	160	0.04	0.3	0.04	...

Table 78. **The nutritive value of**

Name of foodstuff	Moisture %	Protein %	Fat %	Mineral matter %	Fibre %	Carbohydrate%
Fruits:						
54 Apple	85.9	0.9	0.1	0.3	...	13.4
55 Amla (Indian gooseberry)	81.2	0.5	0.1	0.7	3.4	14.1
56 Banana	61.4	1.3	0.2	0.7	...	36.4
57 Guava	76.1	1.5	0.2	0.8	6.9	14.5
58 Lime	84.6	1.5	1.0	0.7	1.3	10.9
59 Mango, ripe	86.1	0.6	0.1	0.3	1.1	11.8
60 Orange	87.6	0.9	0.3	0.4	...	10.6
61 Papaya, ripe	89.6	0.5	0.1	0.4	...	9.5
62 Pears, country	86.9	0.2	0.1	0.3	1.0	11.5
63 Pineapple	86.5	0.6	0.1	0.5	0.3	12.0
64 Plantain (ordinary)	73.4	1.1	0.1	0.7	...	24.7
65 Tomato, ripe	94.5	1.0	0.1	0.5	...	3.9
66 Tamarind pulp	20.0	3.1	0.1	2.9	5.6	67.4
Milk and Milk Products:						
67 Milk, cow's	87.6	3.3	3.6	0.7	...	4.8
68 Milk, buffalo's	81.0	4.3	8.8	0.8	...	5.0
69 Milk, goat's	85.2	3.7	5.6	0.8	...	4.7
70 Milk, human	88.0	1.0	3.9	0.1	...	7.0
71 Curds (from cow's milk)	90.3	2.9	2.9	0.6	...	3.3
72 Skimmed milk powder (from cow's milk)	4.1	38.0	0.1	6.8	...	51.0
73 Milk condensed, sweetened (from cow's milk)	27.0	8.1	8.4	1.6	...	55.0
74 Whole milk powder (from cow's milk)	3.5	25.8	26.7	6.0	...	38.0
Flesh Foods:						
75 Egg, duck's	71.0	13.5	13.7	1.0	...	0.7
76 Egg, hen's	73.7	13.3	13.3	1.0	...	...
77 Fish	77.9	21.5	1.6	2.0	...	...
78 Liver, goat	70.4	19.3	7.5	1.5	...	1.4
79 Mutton (goat)	71.5	19.8	13.3	1.3	...	...

Common foodstuffs *(Continued)*

Calcium (Ca) %	Phosphorus (P) %	Iron (Fe) mg.%	Calorific value per 100 g.	Vitamin A value (I.U. per 100 g.)	Vitamin B_1 (mg. per 100 g.)	Nicotinic acid (mg. per 100 g.)	Riboflavin (mg. per 100 g.)	Vitamin C (mg. per 100 g.)
0.01	0.02	1.7	56	...	0.03	0.2	0.03	2
0.05	0.02	1.2	59	...	0.03	0.2	0.03	700
0.01	0.05	0.4	153	...	0.04	0.3	0.03	1
0.01	0.04	1.0	66	...	0.03	0.2	0.03	300
0.09	0.02	0.3	59	26 (juice)	0.02	0.1 (juice)	0.02	63 (juice)
0.01	0.02	0.3	50	4,800	0.04	0.3	0.05	24
0.05	0.02	0.1	49	350	0.05	0.3	0.06	68
0.01	0.01	0.4	40	2,020	0.04	0.2	0.05	46
0.01	0.01	0.7	47	14	0.02	0.2	0.03	...
0.02	0.01	0.9	50	60	0.03	0.2	0.04	63
0.01	0.03	0.5	104	124	0.04	0.2	0.05	6
0.01	0.02	0.1	21	320	0.04	0.3	0.05	32
0.17	0.11	10.9	283	100	0.06	0.7	0.04	3
0.12	0.09	0.2	65	180	0.05	0.1	0.20	1.6
0.21	0.13	0.2	117	162	0.04	0.1	0.19	1.5
0.17	0.12	0.3	84	182	0.04	0.1	0.15	1.5
0.12	0.01	0.2	67	208	0.02	0.1	0.05	2.2
0.12	0.19	0.3	51	130	0.06	0.1	0.20	1.6
1.37	1.00	1.4	357	0	0.45	1.0	1.64	4.8
0.28	0.23	0.4	328	430	0.05	0.2	0.41	0
0.95	0.73	0.6	496	1,400	0.31	0.8	1.36	4.4
0.07	0.26	3.0	180	2,100	0.12	0.2	0.33	...
0.06	0.22	2.1	173	2,200	0.13	0.1	0.35	...
0.06	0.41	2.3	100	26	0.10	3.0	0.15	...
0.01	0.38	6.3	150	22,300	0.36	17.6	3.20	20
0.15	0.15	2.5	194	31	0.18	6.8	0.27	...

Table 78. **The nutritive value of**

Name of foodstuff	Moisture %	Protein %	Fat %	Mineral matter %	Fibre %	Carbohydrate %
80 Prawn	77.9	20.8	0.3	1.4	...	...
81 Fowl	72.2	25.9	0.6	1.5	...	...
Miscellaneous Foods:						
82 Arrowroot flour	16.5	0.2	0.1	0.1	...	83.3
83 Betel leaves	85.4	3.1	0.8	2.3	2.3	6.1
84 Cocoanut water	95.5	0.1	0.1	0.4	...	4.0
85 Jaggery	3.9	0.4	0.1	0.6	...	95.0
86 Sago	12.2	0.2	0.1	0.3	...	87.2
87 Vermicelli	11.4	10.3	0.7	0.8	0.2	76.6
88 Yeast, dried (food)	7.8	35.7	1.8	8.4	...	46.2

Common foodstuffs (*Continued*)

Calcium (Ca)%	Phosphorus (P) %	Iron (Fe) mg. %	Calorific value per 100 g.	Vitamin A value (I.U. per 100 g.)	Vitamin B_1 (mg. per 100 g.)	Nicotinic acid (mg per 100 g.)	Riboflavin (mg. per 100 g.)	Vitamin C (mg. per 100 g.)
0.09	0.24	0.8	86	Trace	0.09	4.8	0.10	...
0.03	0.25	1.5	109	230	0.08	5.7	0.16	...
0.01	0.02	1.0	334	0	0	0	0	0
0.23	0.04	5.7	44	9600	0.07	0.7	0.03	5
0.02	0.01	0.5	17	...	0.02	0.1	0.02	2
0.08	0.04	11.4	383	280	0.02	1.0	...	...
0.01	0.01	1.3	351	0	0.02	0	0	0
0.02	0.10	1.5	354	...	0.11	1.1	0.03	0
0.16	2.09	21.5	344	...	3.20	27.0	4.5	0

Table 79. **Oxalic acid content of foodstuffs**

Name of foodstuff	*Oxalic acid* mg/100 g.
Cereals	
Bajra (cambu)	14.4
Cholam	12.6
Maize or corn	9.9
Rice raw (Home pounded)	4.6
Ragi	45.7
Wheat	11.1
Pulses	
Bengalgram (with husk)	2.4
Blackgram („)	27.8
Lentil (Masur dhal)	21.4
Soyabean	77.0
Leafy vegetables	
Cabbage	12.0
Coriander leaves	5.0
Lettuce	13.6
Spinach	658.0
Mint	3.8
Mustard leaves	128.7
Roots and tubers	
Beet root	40.4
Carrot	5.6
Colocasia	133.4
Onion	1.0
Potato	15.0
Radish	9.2
Tapioca	17.1
Other vegetables	
Asparagus	1.7
Ash gourd	3.4
Bitter gourd	0.5
Brinjal	29.1
Cauliflower	6.8
French beans	31.2
Ladies fingers	10.3
Peas, green	6.0
Plantain, green	524.0
Snake gourd	1.0

Table 79. Continued

Name of foodstuff	*Oxalic acid* mg/100 g.
Tomato ...	5.3
Turnip ...	0.8
Rhubarb stalk ...	1336.0
Fruits	
Apple ...	1.5
Banana ...	2.2
Grape fruit ...	3.4
Orange ...	8.7
Mango ...	30.0
Pine apple ...	5.8
Nuts and Oilseeds	
Almonds ...	407.3
Cashew nut ...	318.4
Sesame seed (*sesamum indicum*) (with husk)	1908.0
,, (without husk) ...	105.0
Dairy products	
Milk, fresh-whole ...	0.2
Milk, fresh (skimmed) ...	0.2
Milk (condensed) ...	0.4
Milk (Malted dry) ...	0.2
Butter milk ...	0.2
Skim milk powder ...	0.8
Whole milk powder ...	0.8
Egg whole ...	0.2
,, white only ...	0.2
,, yolk only ...	0.2
Flesh Foods	
Fish (Rohi) ...	0.6
Mutton (Goat's meat) ...	0.2
Chicken ...	0.3
Liver ...	0.4
Lamb ...	0.5
Pork ...	0.2
Beef ...	0.2
Miscellaneous	
Cocoa ...	442.0
Coffee ...	15.4
Tea ...	375-1450

Table 80. **Foodstuffs classified according to their content of purines**

High (300 to 1000 mg. purine/100 g. edible portion)	*Moderate* (150 to 300 mg. purine/100 g. edible portion)	*Low or absent* (below 150 mg. purine/100 g. edible portion)
To be avoided	One portion only at each meal	To be taken *adlib.*
Fish roes	Meats	Milk and milk products
Whitebait	Chicken or other birds	Eggs
Sparts	White fish	
Sardines		Cereals
Smelts		Vegetables
Herring		Fruits
Sweetbreads (pancreas or thymus)		Sugar
Liver		
Kidney		
Heart		
Meat extracts and gravies		

Table 81. **Cholesterol content of foods**

Foods	mg/ 100 g.	Foods	mg/ 100 g.
Dairy Products:		Duck	70
Butter	280	Lamb	70
Cheese, Swiss processed	145	Pigeon	110
„ American processed	160	Pork	60
Cream, processed	140	Rabbit	50
Milk, whole	11	Veal	100
„ skimmed	0.4		
„ powder (whole)	88	*Liver:*	
„ powder (skimmed)	0.4	Beef	260
		Calf	360
Poultry products:		Lamb	610
Egg, Hen (whole)	498	Pork	420
„ Yolk	1330		
„ White	0	*Fish and Sea foods:*	
„ Whole (dried)	3900	Cod	50
Chicken, dark	60	Crab	145
„ light	90	Frog	40
		Mackerel	80
Flesh foods: Muscles:		Sardines	70
Beef, round lean	95	Shrimps	150
„ round medium fat	125	Tuna	65

Table 82. **Essential amino acid content of common**

Foodstuff	Botanical name	Arginine	Histidine
1	2	3	4
Cereals and millets:			
Rice	*Oryza sativa*	10.3	1.6
Wheat	*Triticum vulgare*	5.2	1.5
Kaffir corn	*Sorghum vulgare*	6.8	1.6
Oats	*Avena sterilis*	6.1	1.7
Pearl millet	*Pennisetum typhoideum*	8.1	1.7
Ragi	*Eleucine coracana*	5.2	1.3
Barley	*Hordeum vulgare*	4.8	1.7
Italian millet	*Setaria italica*	3.6	2.1
Samai	*Panicum miliare*	4.7	1.9
Corn (Maize)	*Zea mays*	3.5	2.1
Varagu	*Paspalum scrobiculatum*	4.0	1.8
Rajkeera	*Amaranthus paniculatus*	14.8	2.9
Legumes:			
Red gram	*Cajanus cajan*	5.4	3.4
Bengal gram	*Cicer arietinum*	6.9	2.3
Green gram	*Phaseolus radiatus*	6.3	2.7
Lentil	*Lens esculenta*	7.0	2.1
Black gram	*Phaseolus mungo*	5.7	2.7
Cow pea	*Vigna catiang*	6.9	3.1
Horse gram	*Dolichos biflorus*	5.4	3.0
Khesari dhal	*Lathyrus sativus*	7.8	2.5
Field bean	*Dolichos lablab*	9.2	2.8
Peas	*Pisum sativum*	17.7	2.7
Roots and tubers:			
Sweet potato	*Ipomoea batatas*	5.2	1.5
Potato	*Solamum tuberosum*	5.2	1.2
Elephant yam	*Amorphophallus campanulatus*	11.2	1.6
Tapioca	*Manihot utilissima*	7.7	1.5
Colocasia	*Colocasia antiquorum*	6.2	1.8
Green plantain	*Musa paradisiaca*	4.1	4.5

food proteins (g/100 g. protein)

Isoleucine	Leucine	Lysine	Cystine	Methionine	Phenylalanine	Threonine	Tryptophan	Valine
5	6	7	8	9	10	11	12	13
6.0	8.0	3.9*	1.8	2.2	4.6	3.3*	1.2	6.1
3.5	6.5	2.2*	2.2	1.2	5.3	2.6*	1.1	4.0
6.1	12.9	3.4*	1.8	1.6	5.1	3.9*	1.2	5.9
4.8	7.0	3.4*	2.0	1.4	5.0	3.1*	1.2	5.6
5.9	9.5	3.8*	1.9	1.8	4.3	3.8*	1.9	6.3
6.4	9.5	3.4*	2.2	3.0	4.4	3.5*	1.6	6.7
4.0	6.5	3.2*	1.9	1.3	4.8	3.2*	1.2	4.7
7.6	16.7	2.2*	1.8	2.8	6.7	3.1*	1.0	6.9
6.7	10.9	1.8*	1.7	2.3	4.8	3.4*	0.6*	6.1
4.6	13.0	2.9*	1.3	1.9	4.5	4.0*	0.6*	5.1
5.3	8.5	2.1*	2.2	2.8	6.9	3.8*	0.6	5.6
6.9	8.0	8.2	2.2	2.5	4.8	4.4*	0.9	6.1
5.7	7.0	6.4	0.8*	0.9*	9.1	3.4	0.2*	5.1
6.0	8.0	6.4	0.8*	1.7	5.0	4.8	0.6*	5.4
6.3	7.7	7.0	0.6*	1.0*	5.9	3.5	0.4*	6.4
5.4	5.4	5.8	0.8*	0.8*	4.1	2.9	0.3*	5.4
5.5	7.2	6.0	0.7*	1.1*	5.4	4.3	0.5*	6.4
4.9	7.5	6.2	0.7*	1.0*	5.2	3.2	0.6*	6.3
6.7	7.9	8.3	1.3*	0.8*	8.5	3.8	0.6*	5.4
6.6	6.6	6.9	1.4*	0.4*	4.1	2.3	0.4*	4.7
6.0	8.9	8.1	1.0*	0.7*	5.3	3.3	0.5*	5.6
8.4	10.9	11.4	1.2*	1.3*	5.8	4.9	0.7*	7.8
6.2	6.8	5.0	0.7*	1.4*	5.0	5.3	0.8*	9.5
5.2	5.4	6.7	1.2*	1.0*	4.1	3.9	0.7*	5.0
5.0	5.9	4.4	2.1*	1.0*	6.2	4.5	0.6*	5.0
5.3	5.6	6.2	0.9*	0.6*	3.5	3.8	0.5*	4.5
5.2	8.9	6.2	2.7*	1.0*	5.2	4.7	1.4	6.0
5.1	5.4	5.6	0.4*	0.6*	4.5	2.7	0.7*	4.4

Table 82. **Essential amino acid content of common**

Foodstuff	Botanical name	Arginine	Histidine
1	2	3	4
Oilseeds and nuts			
Peanut	*Arachis hypogea*	10.7	2.4
Soyabean	*Glyine max. Merr*	7.2	2.4
Coconut	*Cocos nucifera*	12.1	1.7
Cottonseed	*Gossypium herbaceum*	11.2	2.7
Sesame	*Sesamum indicum*	8.8	1.9
Sunflower	*Helianthus annus*	8.7	2.2
Leafy Vegetables			
Amaranth leaves	*Amaranthus tricolor*	3.8	2.0
Drumstick leaves	*Moringa oleifera*	6.0	2.1
Spinach	*Spinacia oleracea*	6.4	2.8
Milk and egg			
Milk, cow	...	3.7	2.7
Milk, human	...	4.1	2.2
Milk, buffalo	...	3.3	2.1
Milk, goat	...	2.2	2.0
Egg, hen	...	6.6	2.4
Meat and fish			
Beef	...	6.5	3.5
Lamb	...	6.5	2.8
Pork	...	6.1	3.5
Poultry (chicken muscle)	...	6.3	2.9
Fish	...	5.6	...
Miscellaneous			
Food yeast	*Torula utilis*	7.2	2.7
Chlorella	...	7.0	3.5

* Limiting amino acids.

food proteins (g/100 g. protein) (*Continued*)

Isoleucine	Leucine	Lysine	Cystine	Methionine	Phenylalanine	Threonine	Tryptophan	Valine
5	6	7	8	9	10	11	12	13
4.1	5.1	3.6*	1.5*	0.9*	5.1	2.7*	1.1	5.0
5.4	7.7	6.3	1.8*	1.3*	4.9	3.9	1.4	5.3
4.5	6.7	3.8*	1.6*	1.8*	4.3	3.2	0.8	5.3
3.8	5.9	4.3*	1.6*	1.4*	5.2	3.5	1.2	4.9
4.2	7.4	2.6*	2.2	2.8	6.4	3.1	1.5	3.9
4.7	6.4	3.2	1.7	1.6	4.5	3.4	1.3	5.0
4.7	5.9	4.0	0.7	1.1*	2.8	2.2	1.1	4.5
6.3	9.3	4.3	1.8	2.0*	6.4	4.9	1.9	7.1
5.4	8.0	7.6	...	2.0*	5.4	5.5	1.9	7.1
6.5	10.0	7.9	0.9*	2.5*	4.9	4.7	1.4	7.0
5.5	9.1	6.6	2.0	2.4	4.4	4.5	1.7	6.3
5.0	10.2	8.1	1.4*	2.7*	4.3	5.2	1.4	6.2
5.2	8.7	6.3	0.7*	2.2*	4.4	4.3	1.3	5.8
4.6	8.8	6.4	2.3	3.1	5.8	5.0	1.8	7.4
5.2	8.2	8.7	1.3	2.5	4.1	4.4	1.2	5.6
5.2	7.7	8.1	1.3	2.4	4.1	4.6	1.3	4.9
5.1	7.4	8.2	1.2	2.5	3.9	4.6	1.3	5.2
5.3	7.2	8.8	1.3	2.6	3.9	4.3	1.2	4.9
5.1	7.6	8.8	1.3	2.9	3.7	4.3	1.0	5.3
7.2	8.0	7.9	0.9*	1.5*	5.1	5.0	1.4	6.3
5.3	9.0	7.6	0.3*	2.0*	4.1	3.7	2.1	7.9

APPENDIX I

Weight Conversion Table

1 Maund (Railway)	—	40 seers=82 pounds (lbs)
1 Seer (Railway)	—	2.05 lbs=930 grams (g)
1 Chattak	—	2.05 ounces (oz)=58.1 g.
1 Viss	—	3.1 lbs=1.4 kg.=1400 g.
1 Palam	—	35 g.
1 Tola	—	11.6 g.
1 Pound (lb.)	—	16 (oz.)=453.6 g.
1 Ounce (oz.)	—	28.4 g.
1 Kilogram (kg)	—	2.2 lbs.=35.2 oz.=1,000 g.
100 g.	—	3.5 oz.
1 g.	—	1,000 milligram (mg)
1 mg.	—	1,000 microgram (μg)

APPENDIX II

'Adult Consumption Unit' Co-efficients

It is usual to assess the food requirements of women and children in terms of those of the average man. For this purpose, the following 'adult consumption unit' or 'adult man-value' co-efficients are used.

	'Adult consumption unit' co-efficients
Adult male	1.0
Adult female	0.9
Adolescent boys and girls (13–21 years)	1.0
Children (9–12 yrs)	0.8
,, (7–8 yrs)	0.7
,, (5–6 yrs)	0.6
,, (3–4 yrs)	0.5
,, (1–2 yrs)	0.4

These co-efficients are used for assessing the food requirements of a group of mixed age and sex composition e.g., family or groups of families or the entire

population of a country. For example, the food requirements of a family consisting of father, mother and 3 children aged 10, 8 and 6 years respectively, in terms of 'adult consumption units', are given below:

	'Adult consumption unit'
Father	1.0
Mother	0.9
Child (10 yrs)	0.8
„ (8 yrs)	0.7
„ (6 yrs)	0.6
Total	4.0

The above scale is only, at best, an approximation. Physique, physical activity and climate are so variable in different areas that the same scale of food requirements and co-efficients may not be suitable for application throughout the country. A somewhat higher food intake would be appropriate in North India (particularly during the winter months) than in South India. Though the requirements of an average woman are less than that of an average man, the needs of an expectant or a nursing mother may, however, be equal to or greater than those of a man because of the additional food required to nourish the foetus or the child (see Table 43 in the text).

Table 83. **What the Nation spends on food**

States	Urban			Rural		
	Expenditure (%) on			Expenditure (%) on		
	Milk and Milk products	Food grains	Total food per cent of total monthly expenditure	Milk and Milk products	Food grains	Total food as per cent of total monthly expenditure
Andhra Pradesh	7	32	63	4	43	66
Assam	5	24	58	3	40	68
Bihar	8	33	65	5	51	74
Bombay	10	20	60	10	36	70
Jammu and Kashmir	10	28	64	6	52	77
Kerala	4	23	57	3	33	67
Madhya Pradesh	13	22	55	7	39	62
Madras	6	26	59	3	42	69
Mysore	8	28	63	6	34	61
Orissa	4	30	62	1	53	73
Punjab	20	20	60	26	24	65
Rajasthan	14	24	59	12	32	57
Uttar Pradesh	10	28	59	9	44	72
West Bengal	7	25	62	3	50	74
Union Territories	15	15	52	11	32	63
All India	9	25	60	8	41	68

Sources of data : National Sample Survey Report No. 80, June 1961, Published by the Indian Statistical Institute, Calcutta.

Table 84. **Net Food Supplies and calorie and protein contents of net food supplies in some countries* (1963–65) (Grams/Percaput/day)**

Country	Cereals	Potatoes and other starchy roots	Sugars and Sweets	Pulses, nuts and seeds	Vegetables	Fruits	Meat	Eggs	Fish	Milk	Fats and Oils	Calories	Proteins		
													Animal	Vegetable	Total
Europe															
Italy	358	126	69	24	403	274	97	26	15	372	47	2770	32.6	49.6	82.2
U.K.	215	280	137	16	166	154	203	43	27	595	63	3260	53.1	36.0	89.1
North America															
Canada	185	193	133	15	204	214	230	40	16	640	54	3090	62.4	31.5	93.9
U.S.A.	181	130	131	22	267	223	278	49	13	662	58	3140	65.6	26.7	92.3
South America															
Argentina	366	169	93	8	100	221	242	17	8	301	42	3100	47.9	37.0	84.9
Brazil	314	465	116	89	34	252	73	10	6	173	41	2950	18.7	52.6	71.3
Near East															
U.A.R.	586	40	46	29	281	242	36	4	14	124	20	2930	12.6	71.5	84.1

* FAO Production Year Book, (1966), Vol. 20.

Table 84. (*Continued*)

Country	Cereals	Potatoes and other starchy roots	Sugars and Sweets	Pulses, nuts and seeds	Vegetables	Fruits	Meat	Eggs	Fish	Milk	Fats and Oils	Calories	Proteins		
													Animal	Vegetable	Total
Far East															
Ceylon	356	88	46	67	107	26	5	5	17	48	10	2080	8.3	36.8	45.1
India	404	37	50	61	—	45	4	1	3	123	11	2110	5.7	48.2	53.9
Indonesia	350	329	19	22	—	41	14	3	13	2	13	1980	4.5	33.7	38.2
Japan	401	179	48	42	284	86	28	23	76	94	18	2340	23 6	54.8	78.4
Pakistan	457	27	48	17	37	75	10	1	4	200	16	2260	5.5	45.2	50.7
Philippines	365	120	50	16	75	129	36	7	45	42	7	2020	15.7	32.8	48.5
Africa															
Ghana	158	1072	24	63	84	26	27	1	22	8	11	2030	11.1	35.7	46.8
Uganda	159	1152	27	90	60	20	44	2	11	56	6	2310	10.9	47.5	58.4
Oceania															
Australia	233	118	142	12	184	227	291	33	15	584	40	3160	60.0	30.2	90.2
New Zealand	236	171	115	11	254	188	311	46	18	784	55	3460	75.3	44.9	120.2

Table 85. **Approximate Nutritive Value of some**

Food Preparations	Approximate quantity (per serving)	Approximate wt. (g)	Calories	Protein (g)	Fat (g)
Cereal Preparations					
Corn flakes	1 cup	25	94	2.0	0.1
Beaten rice	1 cup	30	114	1.8	0.2
Puffed rice	2 cups	28	107	1.6	0.2
Oat meal	1 cup	25	101	3.6	1.8
Wheat flakes	1 cup	35	133	3.8	0.6
Baked Products					
Bread, toasted	2 slices	46	120	4.0	1.0
Bun	1 no.	31	100	2.3	2.3
Biscuits	2 nos.	16	64	1.6	2.0
Cake, plain	1 no.	55	180	3.4	4.5
Pulse Preparations					
Bengal gram, puffed	...	1 oz.	106	6.4	1.5
Peas, puffed	...	1 oz.	102	6.5	0.4
Nuts					
Almonds	12–15 nos.	1 oz.	186	5.9	16.7
Cashewnuts roasted	15 nos.	1 oz.	169	6.0	13.3
Coconut, kernel (fresh)	...	1 oz.	127	1.4	11.8
Groundnut roasted	...	1 oz.	155	7.6	11.3
Walnuts	...	1 oz.	195	4.4	18.3
Fruits					
Apple	1 med. size	66	42	0.2	0.3
Banana	1 lar. size	100	99	1.2	0.2
Dates, dried	...	1 oz.	80	0.9	0.1
Figs, dried	6 nos.	50	150	2.0	0.6
Grapes	1 bunch	140	44	0.8	...
Guava	1 med. size	100	66	1.5	0.2
Mango	„	100	39	0.6	0.1
Orange	„	100	54	1.0	0.2

ready-to-serve preparations (per serving)

Carbohydrate (g)	Calcium (g)	Phosphorus (g)	Iron (mg)	Vitamin A value (I.U.)	Thiamine (mg)	Nicotinic acid (mg)	Riboflavin (mg)	Vitamin C (mg)
21.2	0.01	0.04	0.6	...	0.10	0.60	0.02	...
26.3	0.01	0.07	0.5	...	0.02	0.30	0.02	...
24.6	0.01	0.07	0.6	...	0.02	0.20	0.02	...
17.6	0.04	0.09	1.0	...	0.20	0.50	0.05	...
28.1	0.02	0.08	1.0	...	0.03	1.70	0.06	...
23.6	0.04	0.05	0.4	...	0.04	0.60	0.04	...
17.5	0.03	0.04	0.3	...	0.03	0.40	0.03	...
9.9	0.04	0.04	0.1	...	0.01	0.10	0.01	...
31.4	0.08	0.10	0.2	70	0.02	0.20	0.05	...
16.7	0.02	0.88	2.5	...	0.12	0.8	0.08	...
18.0	0.01	0.10	1.4	...	0.12	0.8	0.08	...
3.0	0.06	0.14	1.0	...	0.07	0.70	0.02	...
6.3	0.01	0.13	1.4	28	0.18	0.60	0.05	...
3.7	0.01	0.07	0.5	...	0.01	0.20	0.03	1.0
5.8	0.01	0.11	0.5	18	0.26	4.00	0.08	...
3.1	0.03	0.11	1.4	3	0.13	0.50	...	...
9.9	0.01	0.01	0.2	60	0.03	0.10	0.02	3.0
23.0	0.01	0.03	0.6	430	0.04	0.70	0.05	10.0
19.1	0.02	0.02	3.0	170	0.03	0.20	0.01	...
34.2	0.09	0.05	1.5	40	0.08	0.80	0.06	...
10.2	0.03	0.02	0.4	15	0.06	0.30	0.01	3.0
14.5	0.01	0.04	1.0	...	0.05	0.20	0.03	299.0
8.8	0.01	0.02	4.5	4800	0.04	0.30	0.05	24.0
12.1	0.04	0.03	0.4	200	0.08	0.30	0.03	53.0

Table 85. **Approximate Nutritive Value of some**

Food Preparations	Approximate quantity (per serving)	Approximate wt. (g)	Calories	Protein (g)	Fat (g)
Pineapple	2 slices	168	98	0.6	0.4
Raisins, dried	2 tablespn.	20	52	0.4	...
Tomato, ripe	1 med. size	150	30	1.5	0.4
Fruit Products					
Jam	1 tablespn.	20	58	0.1	0.1
Jelly	1 ,,	20	52	0.1	0.1
Marmalade	1 ,,	20	60	0.1	0.1
Orange squash	1 glass	6 oz.	69	0.1	...
Lemon ,,	1 ,,	6 oz.	69	0.1	...
Pineapple ,,	1 ,,	6 oz.	69	0.1	...
Mango ,,	1 ,,	6 oz.	72	0.1	...
Dairy Products					
Butter	1 tablespn.	½ oz.	103	0.1	11.3
Cheese	1″ cube	1 oz.	112	7.1	9.1
Cream	1 tablespn.	½ oz.	50	0.3	5.2
Ghee	1 ,,	½ oz.	127	...	14.2
Carbohydrate Foods					
Honey	1 tablespn.	20	67	0.1	...
Jaggery		1 oz.	108	0.1	...
Sugar		1 oz.	114	...	...

ready-to-serve preparations (per serving)

Carbohydrate (g)	Calcium (g)	Phosphorus (g)	Iron (mg)	Vitamin A value (I.U.)	Thiamine (mg)	Nicotinic acid (mg)	Riboflavin (mg)	Vitamin C (mg)
23.0	0.03	0.02	0.6	220	0.04	0.40	0.04	40.0
14.2	0.02	0.03	0.6	...	0.04	0.20	0.02	...
6.0	0.02	0.04	0.9	1640	0.08	0.80	0.06	35.0
14.2	0.01	0.02	0.1	...	0.01	0.1	0.01	1.0
13.0	0.01	0.02	0.1	...	0.01	0.1	0.01	1.0
14.7	0.01	0.02	0.1	...	0.01	0.1	0.01	1.0
17.1	0.01	0.02	0.1	56	0.01	0.1	0.01	6.0
17.2	0.01	0.02	0.1	10	0.01	0.1	0.01	4.0
17.2	0.01	0.02	0.1	40	0.01	0.1	0.01	6.0
17.8	0.01	0.02	0.1	480	0.01	0.1	0.01	2.0
0.1	...	...	...	460	...	...	...	...
0.6	0.21	0.15	0.3	400	0.01	0.1	0.12	...
0.5	0.12	0.07	...	220	...	...	0.02	...
...	...	...	...	284	...	...	...	...
16.7	...	...	0.1	...	...	...	...	1.0
27.0	0.02	0.10	3.2	79	...	0.30	...	...
28.4	...	...	...	...	...	...	...	...

Table 86. **Approximate nutritive value of some of**

Food Preparations	Approximate quantity (per serving)	Approximate wt. (per serving)	Calories	Protein (g)	Fat (g)
Cereal and Millet Preparations					
Rice Preparations					
Plain rice	3 plates	504	595	11.9	0.9
Sambar Bhath	1½ plates	485	405	13.5	5.1
Curd Bhath	1 plate	253	221	6.0	7.0
Sweet Rice	1 plate	177	432	3.6	12.0
Iddli	2 nos.	136	130	4.6	0.2
Plain Dosai	2 nos.	100	216	4.1	9.7
Masal Dosai	1 ,,	101	212	4.6	8.4
Pongal (hot)	1 plate	148	200	5.5	6.0
Addai (hot)	1 no.	96	195	6.6	4.4
Wheat Preparations					
Wheat Uppuma	1 plate	128	163	3.8	5.4
Chapatis	2 nos.	57	193	5.0	5.5
Puris	2 ,,	32	136	2.2	8.4
Plain Parathas	1 no.	66	304	4.5	19.6
Ravai Iddli	2 nos.	114	212	5.0	8.5
Kesari Bhath	½ plate	90	282	2.0	14.6
Luchchi	2 nos.	71	346	4.0	24.0
Millet Preparations					
Ragi balls	1 no.	336	446	8.0	7.6
Ragi roti	3 nos.	185	460	8.0	9.0
Maize roti	2 nos.	142	314	9.6	5.5
Jowar roti	2 ,,	150	252	7.5	1.3
Pulse Preparations					
Bengal gram dhal	1 cup	151	284	9.0	16.4
Green gram dhal	1 ,,	142	171	7.0	7.7
Red gram dhal	½ ,,	96	110	6.4	2.0
Dhal Rasam	1½ ,,	196	29	1.5	0.9
Amaranth Sambar	1½ ,,	140	97	5.1	2.7
Radish Sambar	1½ ,,	196	101	4.1	3.6

the common food preparations (per serving)

Carbohydrate (g)	Calcium (g)	Phosphorus (g)	Iron (mg)	Vitamin A value (I.U.)	Thiamine (mg)	Nicotinic acid (mg)	Riboflavin (mg)	Vitamin C (mg)
134.8	0.02	0.20	4.8	...	0.20	3.0	0.09	...
76.2	0.08	0.16	3.4	132	0.20	1.7	0.10	5.1
33.3	0.20	0.10	1.0	242	0.08	0.1	0.20	2.3
77.4	0.01	0.06	0.6	265	0.04	0.5	0.04	...
27.6	0.03	0.08	0.8	8	0.10	1.2	0.05	...
28.2	0.03	0.07	1.5	239	0.10	1.3	0.06	...
29.4	0.04	0.08	1.7	210	0.09	0.8	0.06	3.6
30.5	0.03	0.07	1.6	174	0.09	0.6	0.08	...
31.8	0.03	0.09	2.2	152	0.10	0.8	0.10	2.5
24.7	0.01	0.04	0.7	141	0.05	0.4	0.01	1.2
30.8	0.02	0.13	3.0	128	0.20	2.0	0.05	...
13.0	0.01	0.06	1.3	5	0.06	0.8	0.02	...
27.3	0.01	0.12	2.7	467	0.08	1.7	0.04	...
28.7	0.06	0.08	0.9	289	0.07	0.5	0.03	1.5
35.3	0.04	0.02	0.4	350	0.03	0.3	0.01	...
28.0	0.01	0.03	0.4	583	0.05	0.3	0.02	...
86.8	0.40	0.30	6.0	230	0.50	1.2	0.13	...
87.0	0.40	0.30	6.0	255	0.50	1.2	0.13	...
56.4	0.01	0.30	1.8	62	0.30	1.2	0.08	...
52.5	0.02	0.20	4.5	90	0.24	1.3	0.08	...
25.2	0.07	0.13	3.8	366	0.14	2.4	0.10	2.0
18.4	0.08	0.09	2.7	33	0.14	2.4	0.11	1.6
16.4	0.05	0.07	2.6	64	0.13	0.7	0.7	...
3.8	0.03	0.03	0.9	72	0.03	0.2	0.2	1.5
13.0	0.50	0.08	8.0	2,009	0.07	0.7	0.03	53.0
13.1	0.04	0.07	2.2	73	0.07	0.5	0.03	3.0

Table 86. **Approximate nutritive value of some of**

Food Preparations	Approximate quantity (per serving)	Approximate wt. (per serving)	Calories	Protein (g)	Fat (g)
Green gram dhal Sundal	1 plate	142	259	13.1	9.2
Bengal gram Sundal	1 ,,	142	272	9.7	11.1
Cowpea Sundal	1 ,,	142	255	13.5	8.8
Vegetable Preparations					
Amaranth curry	¼ plate	28	47	2.4	2.3
Brinjal curry	½ ,,	45	122	1.4	10.7
Amaranth Maseel	½ ,,	42	46	2.2	2.6
Cabbage & Carrot curry	½ ,,	56	81	1.5	5.6
Preparations containing milk					
Coffee	1 cup	7 oz.	78	1.9	1.7
Tea	1 ,,	7 oz.	64	0.7	0.8
Cocoa	1 ,,	7 oz.	174	7.5	7.0
Suji Payasam	1 ,,	154	178	3.4	4.3
Rice Payasam	1 ,,	154	178	3.2	4.2
Bengalgram dhal Payasam	1 ,,	140	221	7.7	5.1
Sago Porridge	1 ,,	266	227	3.7	4.0
Wheat suji Porridge	1 ,,	280	263	7.6	6.2
Rice Porridge	1 ,,	193	317	8.7	8.0
Ragi Porridge	1 ,,	280	263	6.9	6.3
Milk (cow's)	1 ,,	7 oz.	218	7.2	8.0
Buffalo milk	1 ,,	7 oz.	300	9.0	16.0
Butter milk (curd from cow's milk 1 : 3)	1 ,,	7 oz.	36	1.8	2.0
Butter milk (curd from buffalo milk 1 : 3)	1 ,,	7 oz.	66	2.4	5.0
Egg, Fish and Meat Preparations					
Omelette	1 no.	39	77	5.8	5.7
Minced Meat Curry	3 nos. with gravy	128	220	11.6	18.0
Meat Fry	1 plate	142	339	21.8	26.0
Fish Fry	1 ,,	100	245	23.4	16.2
Rice-Mutton Pulav	1 ,,	341	686	20.4	39.0

* Vitamin A also contributed by Vanaspathi used in cooking.

the common food preparations (per serving) (*Continued*)

Carbohydrate (g)	Calcium (g)	Phosphorus (g)	Iron (mg)	Vitamin A value (I.U.)	Thiamine (mg)	Nicotinic acid (mg)	Riboflavin (mg)	Vitamin C (mg)
30.9	0.08	0.20	4.8	120	0.24	1.2	0.10	1.1
33.2	0.11	0.15	5.5	198	0.16	1.4	0.08	1.1
30.4	0.05	0.20	2.5	71	0.30	0.9	0.15	1.1
4.1	0.04	0.04	6.6	1,942	0.03	0.4	0.03	51.0
4.9	0.02	0.05	0.9	9	0.03	0.5	0.06	10.1
3.4	0.5	0.05	6.8	1,946	0.02	0.4	0.02	50.0
6.1	0.04	0.12	0.9	1,028	0.04	0.3	0.03	38.0
13.8	0.05	0.05	0.10	77	0.02	0.2	0.09	0.7
13.5	0.03	0.02	...	38	0.01	0.2	0.05	0.3
20.2	0.20	0.15	0.3	306	0.08	0.2	0.34	2.7
31.5	0.09	0.08	0.40	160	0.05	0.1	0.12	...
31.7	0.09	0.08	0.40	160	0.05	0.1	0.26	...
35.9	0.07	0.14	4.7	197	0.05	0.2	0.40	...
44.0	0.14	0.10	0.7	204	0.06	...	0.23	4.0
44.3	0.02	0.20	0.7	306	0.10	0.3	0.34	6.0
52.7	0.24	0.22	1.0	408	0.13	0.2	0.50	8.0
44.7	0.30	0.20	1.7	321	0.20	0.2	0.40	6.0
29.2	0.30	0.20	0.8	408	0.11	0.2	0.50	3.6
29.2	0.50	0.30	0.8	368	0.11	0.2	0.42	3.4
2.8	0.07	0.07	0.2	102	0.03	0.1	0.11	0.9
2.8	0.07	0.07	0.2	92	0.02	0.1	0.10	0.9
0.5	0.03	0.10	1.0	940	0.06	0.1	0.15	...
2.7	0.10	0.10	2.1	277	0.10	0.9	0.20	2.4
4.5	0.23	0.20	3.3	294	0.23	7.8	0.30	7.6
1.4	0.06	0.45	1.2	216	0.11	1.3	0.02	1.0
63.6	0.10	0.22	3.5	100	0.20	6.0	0.20	1.1

(Data taken from Balanced Diets and Nutritive value of Common Recipes, F.T.R.I. 1963).

Table 87. **Weight for age table (birth to 60 months, sexes combined)***

Age (months)	Standard		80% of standard		60% of standard	
	lb–oz	kilos	lb–oz	kilos	lb–oz	kilos
0	7– 8	3.4	5–14	2.7	4– 6	2.0
3	12– 8	5.7	9–14	3.5	7– 8	3.4
6	16– 5	7.4	13– 0	5.9	9–14	4.5
9	19– 9	8.9	15– 9	7.1	11–11	5.3
12	21–12	9.9	17– 6	7.9	13– 3	6.0
15	23– 5	10.6	18–11	8.5	14– 1	6.4
18	24–14	11.3	19–13	9.0	14–15	6.8
24	27– 5	12.4	21–12	9.9	16– 8	7.5
30	29–11	13.5	23–12	10.8	17–13	8.1
36	31–14	14.5	25– 8	11.6	19– 2	8.7
42	34– 2	15.5	27– 5	12.4	20– 8	9.3
48	36– 5	16.5	29– 0	13.2	21–12	9.9
54	38– 4	17.4	30–13	14.0	23– 2	10.5
60	40– 8	18.4	32– 5	14.7	24– 3	11.0

* From Harvard Standards—Stuart and Stevenson, (1959).

Table 88. **Weight for Height, Boys***

Height (cms)	Weight (kg)				
	Standard	90% Standard	80% Standard	70% Standard	60% Standard
112	19.7	17.7	15.8	13.8	11.8
114	20.6	18.5	16.5	14.4	12.4
116	21.3	19.2	17.0	14.9	12.8
118	22.1	19.9	17.7	15.5	13.3
120	22.9	20.6	18.3	16.0	13.7
122	23.7	21.3	19.0	16.6	14.2
124	24.5	22.1	19.6	17.2	14.7
126	25.4	22.9	20.3	17.8	15.2
128	26.4	23.8	21.1	18.5	15.8
130	27.3	24.6	21.8	19.1	16.4
132	28.2	25.4	22.6	19.7	16.9
134	29.2	26.3	23.4	20.4	17.5
136	30.2	27.2	24.2	21.1	18.1
138	31.4	28.3	25.1	22.0	18.8
140	32.5	29.3	26.0	22.8	19.5
142	33.7	30.3	27.0	23.6	20.2
144	35.1	31.6	28.1	24.6	21.1
146	36.2	32.6	29.0	25.3	21.7
148	37.4	33.7	29.9	26.2	22.4
150	38.6	34.7	30.9	27.0	23.2
152	40.0	36.0	32.0	28.0	24.0
154	41.4	37.4	33.1	29.0	24.8
156	43.1	38.8	34.5	30.2	25.9
158	44.7	40.2	35.8	31.3	26.8
160	46.5	41.9	37.2	32.6	27.9
162	48.2	43.4	38.6	33.7	28.9
164	50.2	45.2	40.2	35.1	30.1
166	52.5	47.3	42.0	36.8	31.5
168	54.8	49.3	43.8	38.4	32.9
170	57.0	51.3	45.6	40.0	34.2
172	59.4	53.5	47.5	41.6	35.6
174	62.2	56.0	49.8	43.6	37.3

* Values derived from Harvard Standards—Stuart and Stevenson, (1959).

Table 89. **Weight for Height, Girls***

Height (cms)	Weight (kg)				
	Standard	90% Standard	80% Standard	70% Standard	60% Standard
110	18.8	16.9	15.0	13.2	11.3
112	19.6	17.6	15.7	13.7	11.8
114	20.4	18.4	16.3	14.3	12.2
116	21.2	19.1	17.0	14.8	12.7
118	22.0	19.8	17.6	15.4	13.2
120	22.8	20.5	18.2	16.0	13.7
122	23.6	21.2	18.9	16.5	14.2
124	24.5	22.1	19.6	17.2	14.7
126	25.4	22.9	20.3	17.8	15.3
128	26.4	23.8	21.1	18.5	15.8
130	27.4	24.7	21.9	19.2	16.4
132	28.5	25.7	22.8	20.0	17.1
134	29.5	26.6	23.6	20.7	17.7
136	30.6	27.5	24.5	21.4	18.4
138	31.6	28.4	25.3	22.1	19.0
140	32.8	29.5	26.2	23.0	19.7
142	34.0	30.6	27.2	23.8	20.4
144	35.3	31.8	28.2	24.7	21.2
146	36.5	32.9	29.2	25.6	21.9
148	37.7	33.9	30.2	26.4	22.6
150	38.7	34.8	31.0	27.1	23.2
152	39.8	35.8	31.8	27.9	23.9
154	42.0	37.8	33.6	29.4	25.2
156	43.9	39.5	35.1	30.7	26.3
158	46.4	41.8	37.1	32.5	27.8
160	49.7	44.7	39.8	34.8	29.8
162	52.7	47.4	42.2	36.9	31.6

* Values derived from Harvard Standards—Stuart and Stevenson, (1959).

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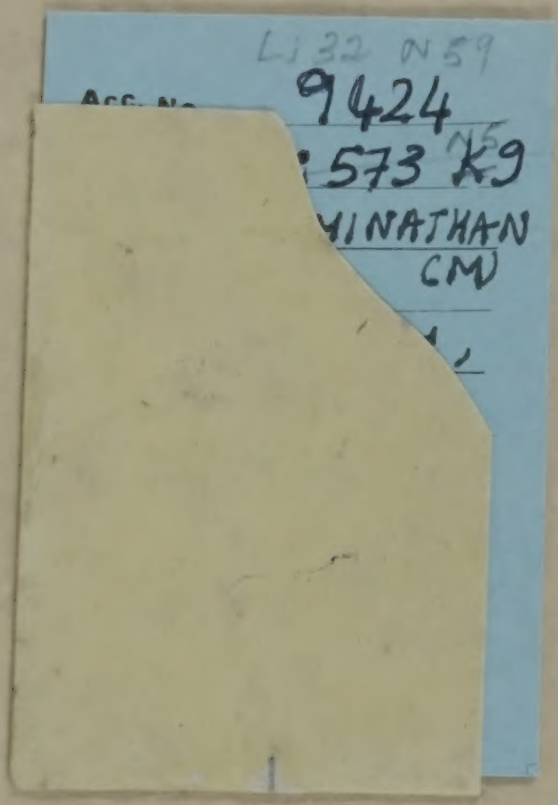
LJ32 N59
9424
573 K9
MINATHAN
CM